The FOUNDRY

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Castings Permit Fine Design In Garden Furniture

WHEN gentle breezes blow and a generous sun looks down to signal the arrival of midsummer, work becomes a menace, and those menaced cast longing eyes on scenes such as the one here shown. The rock garden

Courtesy Manufacturers Record

Rare Examples of Furniture Craftsmanship Are Duplicated in Castings for Furniture Used in the Garden

complete with pool, shade, and abundant vegetation is indeed a pleasant prospect. The fortunate owner of such a garden not only has the pleasure of its use, but also the pride and satisfaction of laying out the design and attending to the details of ornamentation and furnishing. The pool, pathways about its edge, and rough-hewn stone work add to the charm of the setting. Most important of all is the garden furniture, for it must combine utility with a high standard of beauty in design. It must be made of a material which resists weathering and moisture and which is applicable to an infinite variety of designs. Castings of iron or aluminum at once suggest themselves. The furniture shown in the illustration is of cast aluminum and was produced by the Walker Machine & Foundry Corp., Roanoke, Va. Castings permit design intricacy with lightness, strength and resistance to corrosion.

Find Where Castings Can Be Sold

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Budgeting for Profits In the Foundry

MANY foundries today find the task of making a profit difficult if not impossible. Even in normal times, a competition, both intense and many times unintelligent, operates to cut deeply into what would be a fair return on the capital investment in the business. Since the foundry business is one of the most important branches of industry, the effort and energy of foundry owners to render a vitally necessary service entitle them to a proper *margin* over and above the cost of doing business.

I can hear foundrymen exclaim—"Try and get it."

While no doubt there are many elements which contribute to the making of profits, there are three which are vital:

1—Efficient foundry practice.

2—Competent management.

3—Technique which has to do with costs, profits, budgeting, economic factors about the business, and the like.

This article, and one which will follow, will have to do with the latter element.

Let us assume that a foundryman has before him his previous years income statement which, in essence, reads as follows:

Item	Amount	Per 100 Pounds	Per cent
Net sales (3600 tons)	$270,000	$3.75	100.00
Metal cost	79,200	1.10	29.34
Molding cost	57,600	.80	21.33
Coremaking cost	21,600	.30	8.00
Cleaning cost	21,600	.30	8.00
Overhead costs	98,400	1.366	36.44
Total cost	278,400	3.866	103.11
Loss	8,400	.116	3.11

(*Note*—figures are fictitious and illustrative only)

Also let us assume that the capital investment in the business is $280,000, and that 6000 tons constitutes the normal capacity yearly; in other words the practical sales capacity of the foundry under discussion.

Therefore, the income statement as presented, reveals these two essential facts:

1—Foundry operating at 60 per cent of capacity.

2—Loss on capital investment of $280,000 is $8400 or 3 per cent. The interest on the investment at 6 per cent would be $16,800 which shcuild be earned on the money if put out at interest. The shrinkage is therefore $25,200, or 9 per cent.

The question at this point becomes—what is this foundryman going to do about it?

Some years ago, Coleman T. du Pont wrote me that it was no harder to run a steel corpora-

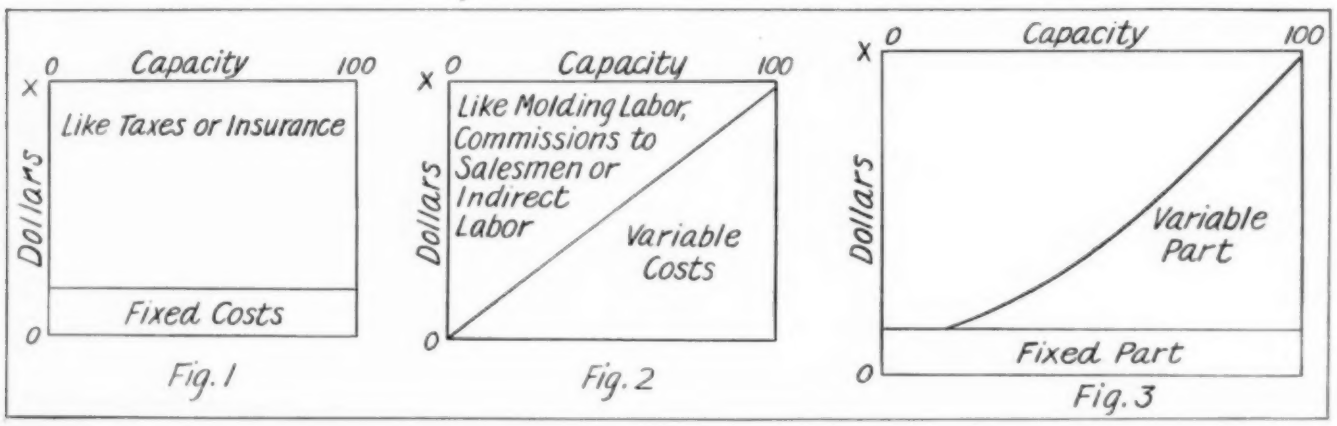


Fig. 1—Fixed Costs Include Taxes and Insurance. Fig. 2—Variable Costs Cover Molding, Labor, Salesmen, Etc. Fig. 3—Both the Fixed and Variable Part Must Be Included

By
C. E. Knoeppel

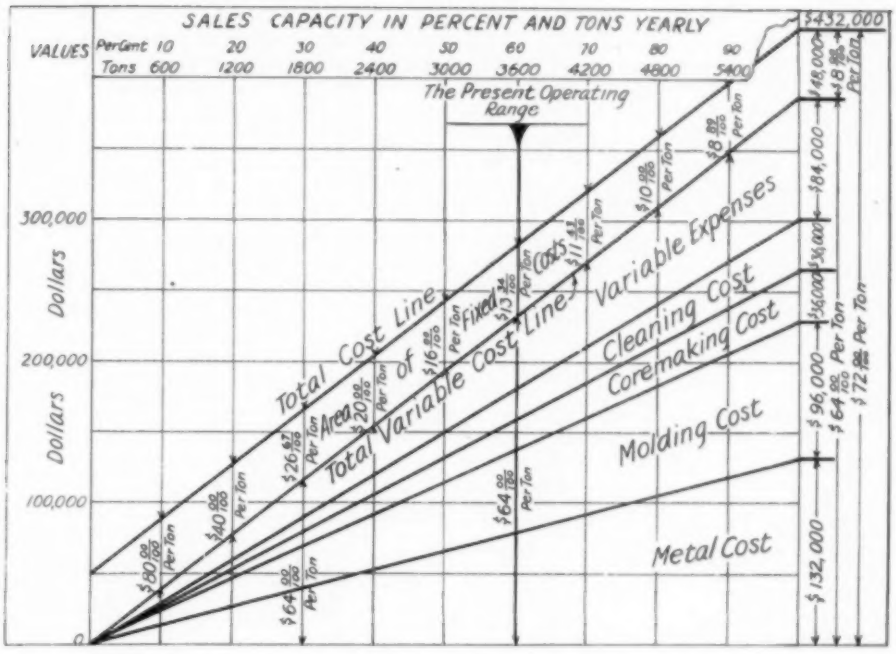


Fig. 4—Chart Showing the Effect of Fixed Costs on the Cost Per Ton of Castings

tion than a peanut stand if it was properly organized, with the administrative (staff) side of the business given as much attention as the executive (line) side. The administrative side is the investigative, formulative, policy-making, planning, advisory side of the business. It is to that side of his business that the foundryman, with the picture before him as previously outlined, must give careful attention. In this connection, Fred W. Shibley, vice president, Bankers Trust Co., New York, in an article in the March, 1929, issue of *Nation's Business,* chose as his title—"It's Easy to Make Business Pay." And Owen D. Young is reported to have said:

"I know of no way concerns can make profits unless they render service, and conversely, if they do not make profits they cannot render service."

In other words, profit is the life blood and motive power of business. It deserves a greater attention than is usually given by those who consider it as something *left over* after other things are taken care of.

Profits in any type of industrial enterprise constitute the following:

Reward for skill, ability, knowledge and experience.

Incentive for effort and endeavor.

Protection against chances which must be taken.

Justification for research and experimentation.

Insurance against losses that are entirely unseen.

Assurance of business perpetuation and success.

Why not think of profit first?

The ship captain at sea must know at all times exactly *where he is at,* to use a slang expression. Not to know would simply invite disaster. So he charts his course and checks his progress by soundings and observations.

This illustration is an apt one from the standpoint of the foundry owner who wants to be successful—successful in the sense of having a profitable business.

Profit comes from an excess of income over outgo. The corollary is that outgo, kept *less* than income, will mean profit. The way out, then, consists in doing one or both of two things —increase volume of sales or reduce costs, or both. This being no time to discuss increased sales, the alternative is to concentrate on costs.

Costs are of three kinds, two of which are shown in Figs. 1 and 2.

Then there is another kind of costs, usually overlooked, which can be pictured as in Fig. 3.

The fixed part of these costs consist of items that are necessary to maintain a minimum personnel and to provide necessary facilities to carry on a going business, and are taken without reference to volume. Beyond the fixed portion, costs are incurred as increasing volume forces the addition of personnel and provision of more facilities.

Costs, Prices and Profit

BASED ON ONE TON

Capacity per cent	Variable cost	Fixed cost	Total cost	Price	Loss	Profit
10	$64.00	$80.00	$144.00	$75.00	$69.00	.....
20	64.00	40.00	104.00	75.00	29.00	.....
30	64.00	26.67	90.67	75.00	15.67	.....
40	64.00	20.00	84.00	75.00	9.00	.....
50	64.00	16.00	80.00	75.00	5.00	.....
60	64.00	13.34	77.34	75.00	2.34	.....
70	64.00	11.43	75.43	75.00	.43	.....
80	64.00	10.00	74.00	75.00	.....	$1.00
90	64.00	8.89	72.89	75.00	.....	2.11
100	64.00	8.00	72.00	75.00	.....	3.00

There is a minimum amount of advertising, clerical, foremanship, and the like, which must be maintained to carry on when business is slack. As business picks up and volume increases, more will have to be spent on these items, varying with the volume, to conduct the right kind of a business.

Therefore let us consider the income statement as it was presented in the introduction, recast it based on the principle outlined, and chart the results. In doing this we will assume that the fixed costs, as in Fig. 1, and the fixed part of fixed-variable costs, Fig. 3, total $48,000.

At 100 per cent capacity, 6000 tons, the income statement values become—

		Per ton
Metal cost	$132,000	
Molding cost	96,000	
Coremaking cost	36,000	
Cleaning cost	36,000	$64.00
Variable overhead cost in total of $98,400 equated for 100 per cent.	84,000	
Total variable costs	384,000	
Fixed costs	48,000	8.00
Total cost	432,000	72.00

Based on these values, the chart shown in Fig. 4 has been prepared. As may be noted, the total cost line increases as the per cent of operation increases. However, one significant fact will be noted when the costs at various points are presented on a basis of the cost per ton of castings produced. This, of course, is secured by dividing the total fixed cost and the total variable cost at any point on the total cost line by the tonnage of castings produced when operating at that capacity. While the variable costs amount to $64.00 *per ton* at any point up or down the capacity scale, the fixed cost charge of $8.00 per ton holds only at 100 per cent capacity. In other words, the fixed cost varies inversely as capacity declines, as may be noted by reading the values in the fixed cost area on Fig. 4. A tabulation of costs, prices and profits on a cost per ton basis is shown in Table I.

In other words, between 70 per cent and 80 per cent capacity, loss ends and profit begins. Obviously, this *neutral* point is too far up the capacity scale. Fig. 4 reveals clearly that costs are too high and must be reduced, to bring the point where loss ends and profit starts lower down on the scale, and to increase the profit margin, thus making for more safety and profitability.

How can this be done?

Through budgeting; budgeting on the *variable* principle; budgeting that is analogous to the *plan of affairs* of the military general, who has his retreat as carefully planned out as his advance; budgeting that also is analogous to the plans and specifications of architect and builder of a house or office building.

In this variable budgeting we will first scrap this old formula which reads—

Sales—(Labor + material + overheads) = Profit (????) for one which reads:—

Sales—([Profit + Fixed expenses] — [Labor + material + variable overheads]) = ZERO

A study is therefore made of the business, budgets are set, and a profit assurance set-up, made of costs and price per 100 pounds of castings at 100 per cent of sales capacity, as follows:—

Sales		$3.75
Profit	$0.50	
Fixed costs	0.40	0.90
Balance for variable items		2.85
Metal cost	1.00	
Molding cost	0.75	
Coremaking cost	0.25	
Cleaning cost	0.25	
Variable overheads	0.60	2.85
Balance		Zero

The problem now is to plan to *live within* this balance of $2.85 per 100 pounds of castings produced.

In plotting the profit course and steering in accordance therewith, use will be made of a graphic profit and loss or income statement. That device is variable automatically up or down the capacity scale, and is known as the profitograph.

This is the first of two articles by Mr. Knoeppel dealing with the idea of budgeting for profits in the foundry. The second and concluding installment will be presented in the July 15 issue.

THE EDITORS

Issues Shovel Bulletin

Wood Shovel & Tool Co., Piqua, O., has issued a complete bulletin on the various types of shovels, scoops, spades and drainage tools that it manufactures. The bulletin describes the factory facilities of the company and explains the workmanship and materials, packing and shipping methods employed. One page is devoted to eight checking points for those interested in buying shovels. Two other pages show the various type grips and handles available and explains how to take measurements on lifts of shovels, spades and scoops. The remainder of the bulletin is devoted to specifications giving list number, size, blade size, weight per dozen, and price of the various items. Each type is shown in a half-tone reproduction.

J. S. Tritle, formerly vice president in charge of manufacturing operations, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed vice president and general manager in charge of manufacturing, sales and engineering operations.

Pittsburgh To Be Scene of Coal Conference

The third international conference on bituminous coal will be held in Pittsburgh, Nov. 16 to 21, at the Carnegie Institute of Technology. The conference will be attended by important delegations from the principle European countries who will discuss the important problems of fuel technology now being considered throughout the world. Subjects discussed will include carbonization, liquefaction and gasification of coal; by-products; mechanism of combustion; cleaning and preparation of coal for the market; pulverized fuel; power plants; domestic heating, etc. Arrangement of the program is in the hands of Dr. Thomas S. Baker, president, Carnegie Institute of Technology, who heads a committee composed of prominent industrialists.

Standards Are Adopted

The heat and corrosion resistant alloy founders' division, Steel Founders' Society of America Inc., composed of manufacturers of heat, corrosion and acid resistant castings, held a meeting in Pittsburgh recently where recommended standards of practice relating to alloy castings supplied for use in industrial furnaces were approved. In some instances through carelessness or from other causes, material supplied for that use was subjected to conditions of fuel, atmosphere and temperature not set forth in the original specifications and requirements. Standards of practice have been adopted to clearly define the liability of the producer in such instances.

Publishes Bulletin

University of Michigan, department of engineering research, Ann Arbor, Mich., recently has issued engineering research circular No. 5 which describes the facilities and service the research department of that institution renders to industry. The first part of the bulletin deals with the service rendered, describes the patent policy followed, outlines some of the problems undertaken, gives the personnel of the research department, and explains the bibliographical and library service available. The remainder of the booklet deals with the laboratory facilities of the institution. A list of research bulletins, circulars and reprints issued by the department of engineering research also is given. The booklet shows views of several sections of the university and some of the laboratories and apparatus used in various projects.

The Tabor Manufacturing Co., 6225 Tacony street, Philadelphia, has opened a sales office at 2842 West Grand boulevard, Detroit.

Outlines Methods for Making

HIGH-TEST GRAY IRON

In the Shop Making Machine Tool and Jobbing Castings

By L. M. Sherwin and T. F. Kiley

MELTING large percentages of steel in the cupola in the production of high-test iron, pouring the product into molds and obtaining a superior casting for certain classes of work, is a problem alive with many chances to go wrong on some particular phase, with resulting loss. Consequently, strict attention must be paid to details. An exact procedure must be worked out and carefully followed.

The procedure outlined in this discussion is the culmination of a great deal of practical foundry research carried on over a period of three years before this material obtained its present status. Obstinate cases of internal shrinkage sponginess and porosity almost invariably can be eliminated by use of low-carbon cast iron, and often this offers the only solution unless it is possible to stop the trouble by the use of chills or feeders. Sometimes chills are the cheapest way out, particularly if the casting has sections less than ¼-inch, or if the section causing the trouble is easy to chill.

Chills May Be Used

However, chills are expensive and always present a hazard in the mold, due to their tendency to collect moisture and cause a blow. During preliminary work on high-test cast iron, many castings were tried which were chilled to get soundness with regular iron mixtures, but which, when tried in high-test iron, invariably were sound without resorting to chills.

Need Close Control

CUPOLA practice, mixtures and materials used in manufacturing a low carbon iron—2.75 to 3.00 per cent—commonly known as high-test cast iron and employed extensively for the successful production of certain classes of castings, are described and illustrated with more than the usual detail by two men who have worked intensively over the problem for the past 3 years. Methods of control, typical analyses of resulting product and microstructures are discussed and comparisons made between machining, strengths and other physical characteristics of this and other or regular mixtures. The work was carried on at the foundry of the Brown & Sharpe Mfg. Co., Providence, R. I., where L. M. Sherwin is foundry and pattern shop superintendent and T. F. Kiley is foundry metallurgist. The article is the first of two abstracted from a paper presented at the Chicago convention of the American Foundrymen's association.

Melting is performed in the same cupola used daily for our regular iron mixtures. It is lined to 54 inches, with a tuyere to cross-sectional area of 1:5. Air is suplied by a turbine blower delivering 6500 cubic feet per minute at a pressure of 12 to 15 ounces.

A high coke bed is carried 60 inches above top of tuyeres. The bed is ignited by an oil burner through the breast. When the flames start to break through the bed, the oil burner is removed and the blast is put on for a few minutes until the bed is brought to an incandescent red all over the top. Charging then is started at once.

Use Plenty Coke

Ton charges and hand charging are used throughout the heat. About 100 pounds of a good grade of limestone and 6 pounds of alkali flux are thrown on the bed. High test returns then are scattered all over the bed. Half the steel charge comes next, leaving a depression in the center for the ferroalloys. Ferroalloys follow, and finally the remainder of the steel, completely covering the ferroalloys. Each split of coke weighs 300 pounds.

A typical charge is made up of steel, 1500 pounds, high test returns 390 pounds, silico-manganese, 25 pounds, ferrosilicon 85 pounds. The steel scrap may be rails, truck tire rims, or cold rolled stock conforming to the following specifications: Carbon, 0.60 per cent maximum, section, ¼ to 1-inch, weight not to exceed 30 pounds, length, 18 inches maximum. Clippings, punchings or similar stock is not accepted. All steel scrap must be clean and free from rust scale.

In the limestone used for flux the

Table I

Mixture Without Returns

Materials charged.	Quantity pounds	Per cent of total charge
Steel	1500	75.0
Ferromanganese (lump 80 per cent Mn.)	30	1.5
Ferrosilicon (lump 50 per cent Si.)	70	3.0
High Silicon Pig: Si. 14.45 per cent; S. 0.16; Mn. 0.15; P. 0.12; T.C. 1.39	140	7.0
High Manganese Pig: Si. 278 per cent; S. 0.025; Mn. 216; P. 0.22; T.C. 380	260	13.0

Table II

Sand Mixtures for Medium Work

Oil Facing Sand:
- 130 quarts Providence fine sand (dried)
- 90 quarts No. 00 Albany molding sand (dried)
- 50 quarts silica flour
- 10 quarts linseed oil

Backing Sand:
- 150 quarts used and crushed backing and oil facing sand
- 120 quarts New England silica sand (Provincetown)
- 7 quarts liquid binder

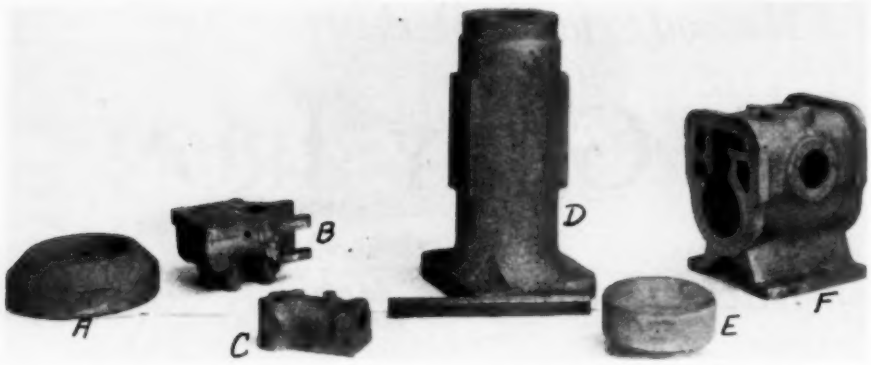


Fig. 1—Castings Shown in Fig. 2 After Being Chipped and Cleaned

sum of the iron oxide, Fe_2O_3, plus alumina, Al_2O_3, plus SiO_2 must not exceed 3.00 per cent. Coke conforms to the following approximate analysis: Sulphur 0.75 per cent, volatile 1.00 per cent, ash 8.00 per cent, moisture 0.50 per cent, fixed carbon 90.50 per cent. The silico-manganese contains from 65 to 75 per cent manganese and from 20 to 25 per cent silicon. The lump ferrosilicon contains 50 per cent silicon.

As a general rule, not over 1 to 2 tons of high-test cast iron are run, and this is always charged first. The cupola then is filled to the door with other grades of iron and allowed to stand for one to two hours before putting on the blast.

Blazing of the bed and the pre-heat prevents a frozen tap hole, and insures hot iron from the start. A breast brick, ⅞-inch diameter hole, is used and the stream is practically continuous after opening the tap hole, except when raising the level of metal for slagging.

High-test iron for medium castings is distributed rapidly to molders by monorail. Hand ladles are dried well and heated with molten iron. Iron must be poured as hot as possible (about 2600 degrees Fahr.), as the rapid setting nature of this type iron will not permit dull pouring.

Iron must be poured into molds for medium work just as rapidly as possible. The gates are about half again as thick as those ordinarily used with a 20 per cent steel mixture. Medium castings often are poured *two up* to get iron into the mold fast enough. Basins are kept well choked and risers and strainer gates resorted to, to insure an absence of slag in castings.

Heavy sections must have ample risers at the high point. With this iron, external liquid shrinkage is greater than with usual grades, and depressions are likely to occur unless fed back. The risers often are fed back with hot iron, but they must be large enough to set later than the casting adjacent, otherwise the riser will draw from the casting, leaving a spongy spot. Molding, gating and pouring must be of a high grade to insure success in casting.

The action of this metal on green sand molds for medium and heavy work is severe, resulting in rough surfaces, cuts, scabs and washes. Green sand molds also result in a large percentage of castings showing slag inclusions and gas holes after machining. This is probably due to moisture in the green sand, which further hastens the setting of an already fast-setting metal and prevents the elimination of gas and slag.

After trying various means to overcome this trouble by use of sea-coal facing, by steel molding sands, and by blacking heavily the surface of molds, green sand had to be abandoned in favor of dry-sand molds on the medium work. The molds are

Table III

Standards for Regular Mixtures

Mixture No.	Mixture	1-in. Square Bar Si	S	Mn	P	T C	C C	Transverse, lbs.	Deflection, inches	Brinell	Shrinkage, inches	Drill Per Cent	A.S.T.M. Bar Transverse, lbs.	Deflection, inches	Tensile strength, lbs. per sq. in.	Type of Casting
1	30% Steel 20% Returns 50% Pig	1.80 2.00	0.10 0.14	0.60 0.90	0.20 0.30	3.20 3.40	0.65 0.80	3300 3600	0.14 0.18	196 217	0.13 0.15	+5.0 +15.0	1900 2300	0.25 0.27	33,000 40,000	Used on fairly heavy work where close grain and strength is essential. Min. section ½ in.
2	5% Steel 45% Returns 50% Pig	1.90 2.10	0.08 0.11	0.50 0.70	0.30 0.50	3.40 3.60	0.50 0.70	2800 3300	0.15 0.18	187 207	0.10 0.14	0.0 —10.0	1900 2200	0.25 0.28	30,000 35,000	Used on regular run of side floor work.
3	20% Steel 30% Returns 50% Pig	1.90 2.20	0.09 0.12	0.60 6.80	0.20 0.30	3.20 3.50	0.60 0.75	3200 3500	0.14 0.17	187 207	0.12 0.14	+5.0 —5.0	2000 2400	0.25 0.28	35,000 39,000	Used on heavy bench, machine and floor work requiring close grain and strength. Min. section ¼ in.
4	50% Returns 50% Pig	2.00 2.40	0.08 0.10	0.50 0.60	0.40 0.60	3.45 3.65	0.40 0.60	2800 3200	0.15 0.18	156 179	0.10 0.13	—10.0 —30.0	1600 2000	0.25 0.29	24,000 30,000	Used on regular run of light work. Min. section ⅜ in.

Table IV

Average Standard Plain High-Test Iron

Mixture	1-in. Square Bar Si	S	Mn	P	T C	C C	Transverse, lbs.	Deflection, inches	Brinell	Shrinkage, inches	Drill Per Cent	A. S. T. M. Bar Transverse, lbs.	Deflection, inches	Tensile strength, lbs. per sq. in.
75% Steel 1¼% Fe.-Mn. 3¾% Fe.-Si. 13% High Mn. Pig 7% High Si. Pig	2.66	0.114	1.05	0.14	2.86	0.63	3298	0.14	241	0.163	+29.0	2216	0.23	41200
75% Steel 1¼% Si.-Mn. 4¼% Fe.-Si. 19½% High-test Ret.	2.84	0.145	1.57	0.04	2.95	0.78	3910	0.14	255	0.160	+41.2	2422	0.25	56700

faced with a fine oil-sand mixture and backed with an open sand, bonded with a liquid binder. The used sand in the backing sand mixtures is taken from crushed dry sand molds after shakeout. Dry sand molds for medium work are baked overnight at a temperature of 425 degrees Fahr.

Lacking facilities for baking the molds for heavier work, a flour-bonded facing sand generally is used with backing of green sand from the sand slinging machine heap. Molds are sprayed with the following mixture: 24 quarts plumbago, 2 quarts bentonite, 2 quarts molasses, 24 quarts water.

Molds then are well skin dried with an oil torch. If precautions are taken to torch the mold shortly before casting, fairly good results are obtained by this method, although baked molds are preferred when possible. Sand mixture contains: 150 quarts heap sand, 70 quarts Millville molding sand, 70 quarts New England silica sand (Provincetown), 10 quarts flour.

Fig. 2—High Test Iron Castings with Gates and Risers Attached

Test bars 1-inch square are cast flat in pairs and gated at one end. Plain bars without projections are tested on a transverse machine, 12 inches between supports, and record is made of transverse breaking load and deflection. Occasionally, tests

Table V

Gray Iron Treated with Molybdenum

Mixture No.	Mixture	1 in. Square Bar, 12 in. Supports: Si	S	Mn	P	T C	C C	Mo	Transverse, lbs.	Deflection, inches	Brinell	Shrinkage, inches	Drill PerCent	A. S. T. M. Bar, 18 in. Supports: Transverse, lbs.	Deflection, inches	Tensile strength, lbs. per sq. in.
3	20% Steel 50% Pig 30% Returns No Alloy	1.88	0.098	0.76	0.24	3.38	0.68	0.0	3464	0.16	196	0.135	—5.6	1994	0.25	30,300
3 plus Alloy	20% Steel 50% Pig 30% Returns plus ½% Fe.-Mo.	1.80	0.10	0.80	0.22	3.46	0.80	0.19	3561	0.17	187	0.130	+7.2	2125	0.29	32,150
3 plus Alloy	20% Steel 50% Pig 30% Returns plus 1% Fe.-Mo.	1.82	0.10	0.73	0.26	3.49	0.67	0.38	3670	0.17	187	0.090	+6.0	2559	0.31	38,950
3 plus Alloy	20% Steel 50% Pig 30% Returns plus 1½% Fe.-Mo.	1.85	0.096	0.81	0.23	3.45	0.77	0.73	3830	0.18	207	0.105	+13.6	2692	0.32	44,300
3 plus Alloy	20% Steel 50% Pig 30% Returns plus 2% Fe.-Mo.	1.89	0.096	0.80	0.25	3.41	0.81	0.82	3915	0.17	228	0.105	+19.3	2843	0.30	47,200
High Test plus Alloy	75% Steel 19½% H.-T. Rct. 4¼% Fe.-Si. 1¼% Si.-Mn 2% Fe.-Mo.	2.92	0.162	1.07	0.10	2.97	0.82	0.82	4138	0.19	302	0.140	+70.0	3071	0.32	59,200

Table VI

Standard Alloy High-Test Iron

Mixture No.	Mixture	1 in. Square Bar, 12 in. Supports: Si	S	Mn	P	T C	C C	Ni	Transverse, lbs.	Shrinkage, inches	Brinell	Deflection, inches	Drill Per Cent
High Test plus Alloy	70% Steel 18½% High Mn. Pig 10% High Si. Pig... ½% Fe. Mn..... 1% Pig Ni.....	1.73	0.163	0.78	0.09	2.79	0.66	1.39	3755	0.140	228	0.14	+34.7
High Test plus Alloy	70% Steel 18½% High Mn. Pig 10% High Si. Pig... ½% Fe. Mn..... 1% Pig Ni.....	2.09	0.160	0.91	0.09	2.86	0.71	1.05	3695	0.160	217	0.16	+24.8

Table VII

Brinell Variations

Outside	Center
228	217
241	228
241	241
241	228
255	241
228	228
269	255
241	241
255	241
241	228

are made on arbitration bar, A.S.T.M. standard, 18 inches between supports.

Contraction is measured on a bar made from pattern with projections 12 inches apart. The distance between projections is measured after casting, and shrinkage that is shown is recorded.

Plain bar is cut off 3 inches from end opposite gate, and Brinell is recorded at the center of cross-sections of the bar.

Test bars from each of various mixtures are drilled with a ¼-inch high speed drill by a special drill press. This is equipped with a weight of 12 pounds, attached to a pulley, and guides which show when the drill has penetrated to a depth of ¾-inch. The time to drill a standard bar is noted in seconds; then the time is noted for drilling a test bar from the various mixtures at the same location. The increase or decrease in time then is recorded in percentage, plus or minus.

Tests Machinability

Inasmuch as the standard bar in the first place was taken from one of our regular mixtures (mixture No. 3, Table III), occasionally a bar is tested which drills in exactly the same time as the standard. Such bars are laid aside and held for future standards. The use of a standard for checking purposes offsets variables in the belt, sharpness of drill, power, etc. The following examples may explain the meaning more clearly:

Time to drill standard seconds	Time to drill test bars, seconds	Difference, seconds	Percentage
27.6	29.8	+2.2	+ 7.8
27.6	20.2	−7.4	− 26.8

In the first example, the sample is 7.8 per cent less machinable than standard; in the second example, the sample is 26.8 per cent more machinable than standard.

The higher the combined carbon in high-test iron up to the eutectoid, the higher is the transverse and tensile strength. Combined carbon generally is higher than with regular iron mixtures.

The brinell hardness is considerably higher than with regular iron mixtures and, unlike regular iron mixtures, shows little variation from outside to center of the arbitration bar. Regular mixtures average 207 on the outside of arbitration bars, but the center varies from 207 to 149. Table VII shows the uniformity in hardness from outside to center of the arbitration bar on several heats of high-test iron.

In general, but not always, the graphite is finer and more uniformly sized and distributed than in regular iron mixtures. Patternmakers' shrinkage on solid contraction is about half way between steel and regular gray iron. It has been necessary to add more for finish on some patterns to take care of that fact.

Deflection is lower than with the usual grades of iron, unless alloys are needed. Transverse and tensile results are considerably higher than the results obtained with regular iron mixtures. Higher strengths and lower total carbons are obtained when 2 tons or more are melted.

High-test iron is more resistant to tool penetration than are regular iron mixtures, as indicated by the drill test. This probably is due to a greater density. However, there is nothing in the structure that would ruin a tool if reasonable feeds and speeds are carried. There is no excess cementite present if iron is of right composition, melted properly and poured into castings having no machine section less than ¼-inch.

Molybdenum Is Used

Table V gives a record of physical properties of mixture No. 3, to which was added varying percentages of ferromolybdenum (up to 2 per cent) at the spout, and also a heat of high-test, low-carbon iron to which 2 per cent ferromolybdenum was added. A study of this table would seem to indicate that when using up to 2 per cent ferromolybdenum, the following results are obtained: (a) Molybdenum raises the combined carbon but not to above the eutectoid, (b) increases transverse strength considerably, (c) increases brinell hardness values, (d) increases tensile strength considerably, (e) increases time of machining as evidenced by drill test, but this is due to increased density or toughness and not to any hard spots or structure that would ruin a tool, (f) decreases solid contraction or patternmakers' shrinkage, (g) sorbitizes the pearlite, leading to increased strength and toughness, (h) graphite flakes appear to be somewhat smaller and more uniformly distributed and sized, a further explanation of increased strength and toughness (i) increases deflection.

It will be noted that molybdenum raises the strength of an ordinary semisteel mixture equal to the strength of some heats of high-test iron, and more than others. When this was noted, it was first thought that an iron treated with molybdenum might exhibit the same characteristics as a high-test, low-carbon iron in reducing internal liquid shrinkage, porosity, sponginess or draws between adjoining thin and heavy sections.

Expected Results Not Obtained

Castings made successfully without chills in high-test, low-carbon iron were tried in molybdenum treated irons (mixture No. 3 plus alloy, in Table V), but invariably showed the same defects exhibited by plain mixture untreated. That is, we cannot take an ordinary iron mixture which is giving trouble with sponginess or shrink in casting and, by dropping in a little molybdenum, thereby produce a sound casting.

An advantage of molybdenum is that it offers a ready means of obtaining fairly high transverse and tensile strengths without using mixtures containing high percentages of steel. However, we believe that high-steel mixtures can be improved in strength further by molybdenum additions.

Apparently, molybdenum would be a valuable aid in insuring consistently high strengths, inasmuch as our plain, high-test iron tends to vary between fairly wide limits, say, 40,000 to 60,000 pounds per square inch tensile, strength.

This is the first of two articles by L. M. Sherwin and T. F. Kiley. The second will appear in an early issue.

THE EDITORS.

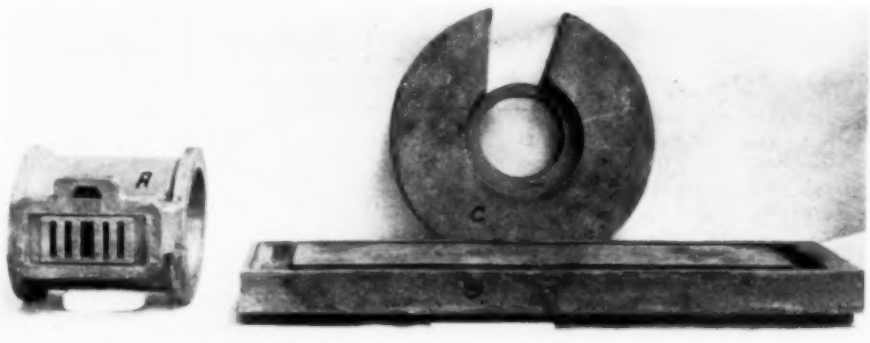


Fig. 3—High Test Castings From Mixture Which Is Shown in Table VI

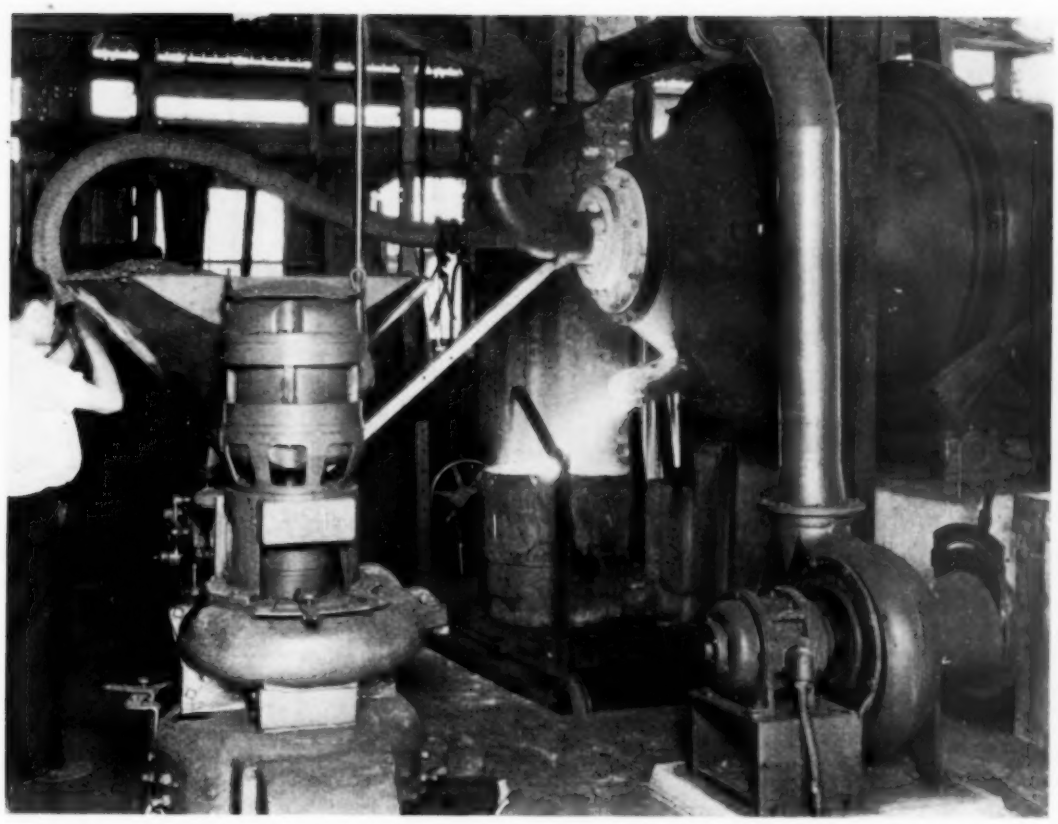


Fig. 1—Tapping the Furnace. The Metal Temperature Was 2840 Degrees Fahr.

Produces Special Purpose Iron In Rotary Furnaces

ADVANCEMENT made in the mechanical arts during the past decade has led to the demand for gray irons of high strength and quality. Many methods have been developed to meet that demand, including improvement in cupola practice, addition of steel scrap in the charges, addition of alloys to the metal, and the employment of various types of melting units.

One of those is a rotary type furnace, fired with powdered coal which was developed in Germany by Brackelsberg. The unit is designed especially for the production of high grade iron castings and alloy gray iron castings containing nickel, chromium, vanadium, molybdenum, copper, manganese, etc . The furnace also is used for the production of malleable iron and it may be employed in melting steel. There are about 30 furnace installations in Germany, France, England, Italy and the United States.

The furnace consists of a cylindrical drum with removable conical ends for convenience in relining and repair. The drum rotates within a cradle and is carried on two steel tires around the drum. The tires engage power-driven rollers on the tilting cradle, and give the drum the 15 feet a minute rotation required during the heat. The cradle is carried on two trunnions supported in standards at the side of the cradle and located at the center of gravity of the drum and cradle. Tilting is accomplished by gear segments attached to the cradle and driven by pinions supported in bearing blocks on the concrete foundation. The tilting mechanism is used in charging, pouring and cleaning.

Table I

Chemical Data

Element	Charge	Heat 1	Heat 2	Heat 3
Silicon	1.93	1.76	1.79	1.83
Sulphur	0.050	0.063	0.062	0.062
Phosphorus*	0.53	0.65	0.68	0.68
Manganese	0.61	0.38	0.39	0.40
Carbon	.....	2.90	3.02	3.08
Pounds coal per ton iron		688	458	470

*The difference in phosphorus content in charge analysis and finish analyses is due to variation in phosphorus content of scrap material used.

Fig. 6 shows a 2-ton furnace in operation with the stack connection moved back to show the length of the flame. There are no manual operations as tilting and rotating motions are mechanical. The control of these movements is remote and can be located where it is most convenient for the particular installation.

The inside diameter of the drum of a 2-ton furnace is 4 feet 11 inches and the overall length is 14 feet 9 inches. The diameter of the drum of a 5-ton furnace is 7 feet 5 inches and the over-

all length is 19 feet. Inside diameter of a 10-ton furnace is 8 feet 2 inches and the overall length, 22 feet.

A two-ton furnace has been in operation in this country for some time, using its original rammed ganister lining. Over 160 heats have been melted to date, 39 of which were melted with no patching. Over 200 heats to a lining is considered average continental practice, although one company has had more than 400 heats with one lining, which is still in service.

Life of the lining depends largely on the care taken in patching. If the furnace is patched after every 5 or 6 days of operation, which means 10 to 24 heats between patchings, any excessive wear at one spot may be taken care of as it occurs and the life of the lining prolonged to a large number of heats.

Because of the rotating action ,the heat in the lining is transferred continually to the metal which exerts a cooling action on the lining. No one part of the lining is subjected to a higher temperature than the rest which may account for the long life obtained from linings. It also may account in part for the economy in fuel.

All the furnaces in operation to date are run on an acid lining, but it is possible to use a basic lining if necessary, keeping in mind that a basic lining will cost more than an acid lining. The small amount of limestone used on an acid lining has not been found to affect the lining and as little as 0.3 per cent limestone will produce a fluid slag.

An insulating lining may be placed between the furnace shell and the refractory lining. Continental furnaces have an insulating lining. Insulation will reduce the amount of heat radiated and increase the maximum flame temperature obtainable, but it is not considered essential for good operation. The refractory lining varies from 15 to 24 inches in thickness, depending on the size of the furnace.

Auxiliary equipment like pulverizer and fan need not be located directly at the furnace but if necessary at a remote point, depending upon the layout of the plant and the space available around the furnace.

The pulverized coal required for firing a rotary furnace may be supplied either by a central plant system or by a direct-fired system. When connected to a central plant system, a pulverized coal hopper is installed at the furnace and coal fed from the bottom of the hopper by a screw feed. The feed screw has variable speed control regulating the amount of coal used per minute. When direct firing is employed, a small pulverizer with air separation is installed with the furnace as shown in Fig. 1.

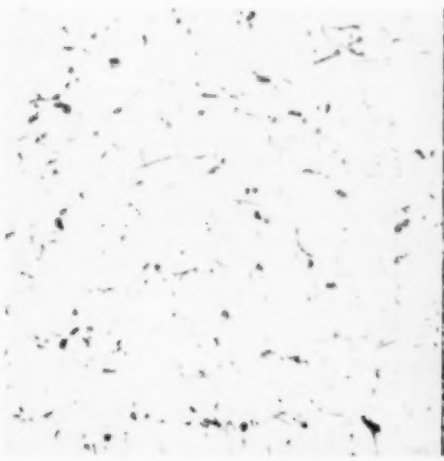
Suitable fan equipment is necessary to convey the pulverized coal to the burner and supply air for combustion. Fans are supplied with adjustable air gates to regulate the amount of air delivered. When the amount of coal delivered per minute is established and the fans have been calibrated properly, a standard firing schedule is used. The auxiliary equipment in fans and coal feed is important, and

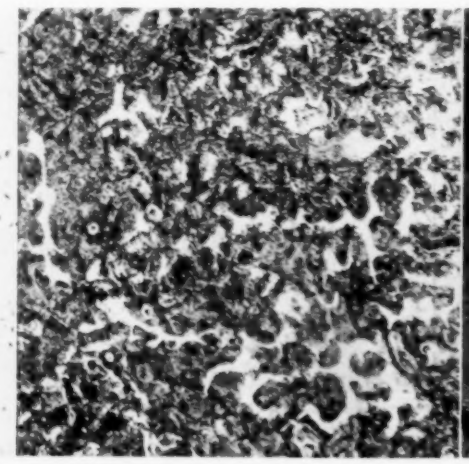
Fig. 2—When the Furnace Is To Be Charged, It Is Tilted at an Angle of 45 Degrees. A Chute from the Elevated Platform Conveys the Charge into the Furnace

Table II

Brinell Hardness

Heat No.	Taken at Center of Test Piece	Taken Half Between Center and Edge
A 1	241	235
B 3	228	241
C 3	228	228
D 2	228	217
E 3	228	241
F 3	235	255
G 2	217	217
H 2	241	248
H 3	241	228
J 3	248	241
Average	234	235





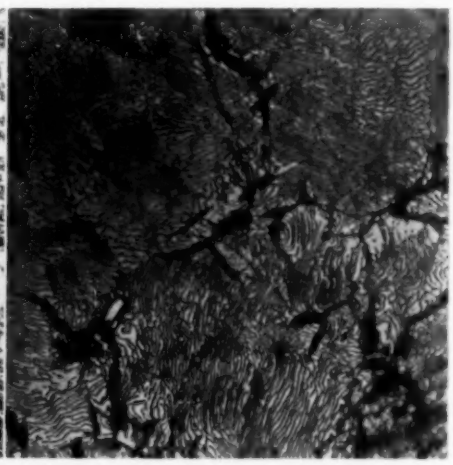


Fig. 3—Iron Melted in a Rotary Furnace, at 100 Diameters, Unetched. Fig. 4—Same Iron at 100 Diameters, Etched. Fig. 5—At 500 Diameters the Etched Specimens Show the Pearlitic Structure More Clearly

to secure uniform results, correct design and engineering are necessary.

A furnace stack, brick or brick-lined, is used to carry the products of combustion and ash out of the foundry building. A recuperator may be installed between the furnace stack and the burner. Any amount of preheat obtained in the secondary air means a higher flame temperature, increased speed in melting, and a higher maximum temperature obtainable. While it is not necessary to use a preheater to melt gray iron or malleable iron, it is regarded essential when melting steel.

The furnace is charged in an inclined position, as shown in Fig. 2. After the furnace is charged, it is tilted to a horizontal position for melting. If the furnace is cold, a small wood fire is started at the burner end; a hot furnace does not require the wood fire. The burner then is swung into position, and the firing equipment started. Rotation is not started until the charge is melted down. During rotation the components of the charge are mixed.

Take Temperature Readings

Progress of the melt can be determined by the appearance of the flame and the lining. An optical temperature reading of the lining gives a relative reading of the bath temperature. It is also possible to take spoon tests for temperature and fracture. Additions of ferroalloys or other alloys may be included in the charge or added during the melt. When the bath is ready for pouring, the tap-hole is rotated to a position where it can be cleaned properly and then rotated to down position for pouring as shown in Fig. 1. All the metal can be poured from the furnace at a consistent rate by tilting the furnace a few degrees.

After the metal is entirely drained, the furnace is tilted to charging position and slag is removed from the rear end. The small amount of slag at the discharge end of furnace, shown in Fig. 2, is from the heat just tapped. After the slag is drained, the opening at that end is closed to keep the charge within the furnace. One man with a helper, who is used occasionally, supply the labor necessary to operate the furnace.

A characteristic of the rotary melting unit is the high quality of the iron produced. Total carbon may be controlled closely and any desired carbon content may be obtained by regulating the mixture. A 3.00 per cent total carbon content is obtained compared to 3.30 to 3.70 per cent in ordinary iron. This gives the iron much greater strength and toughness. Tables II, III and IV show results of a series of tests made on standard arbitration bars designated in the American Society for Testing Materials specification A 48-29.

Micrographs shown in Figs. 3, 4 and 5 were made from standard test bars of iron melted in a 2-ton rotary furnace. Fig. 3 shows an unetched sample at 100 magnifications. Graphite flakes in Fig. 3 are small and uniformly distributed. The pearlitic structure of the rotary furnace iron is indicated in Fig. 5.

Table I shows the results from three consecutive heats of gray iron melted in a 2-ton furnace. All the charges were 4000 pounds. The first heat was melted in a cold furnace and the other two in a hot furnace. The charge contained the following: 50 per cent pig iron; 43.8 per cent scrap iron; 6.2 per cent steel rails, and 20 pounds of limestone (0.5 per cent of the weight of the charge). These heats were run in a district where the phosphorus content of the scrap varies from 0.50 to 0.90 per cent. The phosphorus content of the scrap was figured at 0.50 per cent in the charge data.

The average transverse breaking strength for 12 bars, poured four to a heat, was 4110 pounds and deflection averaged 0.14 inches. These tests were made on 1.25-inch round bars, broken on 12-inch centers.

The analysis shows good uniformity for the different heats made of the same charge. When limestone amounting to 2 per cent of the weight of the charge was added, the sulphur increase was nil. When 0.5 per cent or less was added, the sulphur increase was 0.015 to 0.020 per cent. There is no change in phosphorus on an acid lining.

Temperatures ranging from 2700 to 2850 degrees Fahr. are obtained in ordinary operation. By the use of a preheater, the temperature may be

Table III

Tensile Tests

Heat No.	Area Sq. In.	Tensile Strength Lbs. per Sq. Inch
A 1	0.5026	43,240
A 2	0.5026	39,080
B 1	0.5039	43,200
B 2	0.5026	42,720
C 1	0.4976	43,090
C 2	0.5026	41,960
D 1	0.4963	43,620
D 2	0.5026	44,470
E 1	0.5026	43,020
E 2	0.5026	45,800
F 2	0.5026	40,250
F 3	0.5026	34,640
G 2	0.5026	38,600
G 3	0.5026	40,990
H 1	0.5026	**46,460**
H 2	0.5026	43,460
I 1	0.5026	39,140
I 2	0.5026	39,280
J 1	0.5026	46,000
J 2	0.5026	45,280

The tests were made on the standard tensile test bar prescribed by the A.S.T.M. Specifications A-48-29.

Table IV

Transverse Tests

Heat No.	Total Load Pounds	Deflection Inches	Fracture
A 4	2840	0.223	OK
B 1	3250	0.262	OK
B 4	2980	0.220	OK
C 1	2720	0.235	OK
C 4	3040	0.255	OK*
D 4	2800	0.231	DK
E 1	3000	0.234	OK
E 4	2960	0.216	OK
F 1	2830	0.224	OK*
G 1	2950	0.245	OK**
G 4	3000	0.248	OK
H 4	3000	0.230	OK
I 1	2800	0.227	OK
J 2	3100	0.231	OK
J 4	3170	0.222	OK

(*) Small flaw.
(**) Two small flaws.

The tests were made with 18-inch spans on the standard arbitration test bars prescribed by the A.S.T.M. specification A-48-29.

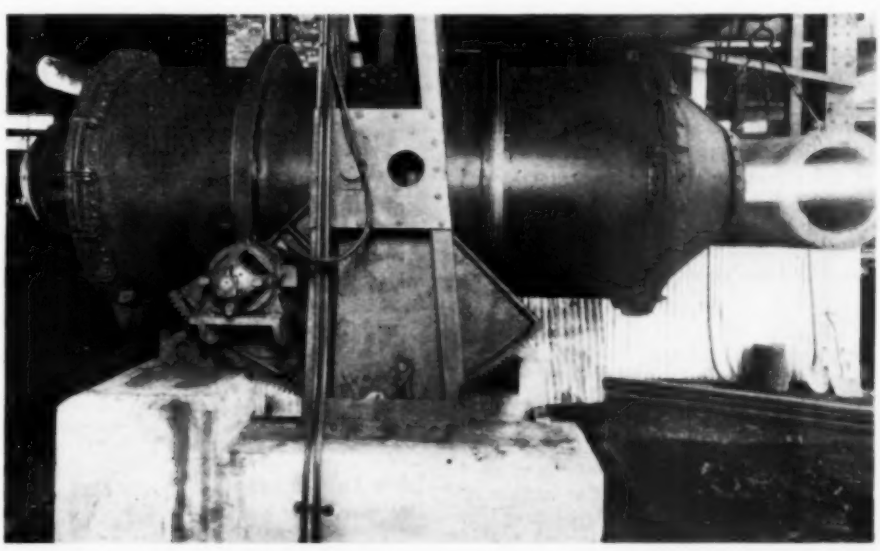


Fig. 6—Powdered Coal-fired, Rotary Furnace in Operating Position with Elbow Removed to Show Flame

brought up to as high as 3100 degrees Fahr.

Low-priced bituminous coal in pulverized form is used for fuel. The only power required is for operating the pulverizer and for tilting and rotating the furnace—approximately 12 kilowatt hours per ton of melt. When duplexing, still less power is required.

The rotary furnace is designed as a flexible unit and may be operated day or night, either full capacity or part capacity, according to volume of iron required. The mixture may be changed every heat if desired—the same furnace may be used for various grades of gray iron, special alloys, malleable iron, etc. After a heat, the furnace may be charged again and held ready for the next day; the charge thus absorbing heat from the furnace. Equally satisfactory metallurgical results have been obtained when operating at part or full capacity.

In the operation of the furnace, it has been found that the loss of iron by oxidation is low, averaging less than 2 per cent. The saving is credited to the fact that no gases pass through the metal and the metal is at all times covered by a protective coating of slag. Also, the pulverized coal flame is directed towards the lining, which gives up its heat from the underside of the bath during rotation. By firing with powdered coal, control of air and coal feed is obtained and only sufficient air added to give complete combustion.

A good grade of bituminous coal is used to fire the Brackelsberg furnace. On an American installation a Pennsylvania slack coal, costing $1.00 per ton at the mines, is used. The approximate analysis of this coal is as follows: Moisture, 1.7 per cent; voltile matter, 34.2 per cent; fixed carbon, 54.7 per cent; ash, 9.4 per cent; sulphur, 1.2 per cent; fusion point of ash, 2500 degrees Fahr., and B.t.u., dried coal, 13,790. A 2-ton furnace operating at Birmingham uses local coals. These coals are similar to Pennsylvania coal except the volatile matter is about 30 per cent.

On the 2-ton furnace, starting up cold, the iron to fuel ratio is about 3 to 1; after the first heat the ratio is increased up to 4½ or 5 to 1, while on the larger sizes a ratio of 6 to 1 is obtained.

Reader's Comment

Editor's Note—*Material Appearing Under This Head Does Not Necessarily Reflect the Opinion of* **The Foundry** *or of Its Editors.*

Questions Gating Formula

To the Editors:

In H. W. Dietert's formulas quoted on page 85 in the May 15 issue of The Foundry a constant X is given varying for different thicknesses. I am wondering what the value of this constant should be for castings varying in thickness between ¾ and 2 inches.

Also in checking through the various equation factors I find none referring to the area of the metal line. Consider a plate or slab 3 inches thick, 12 inches wide and 36 inches in length. Does the equation in its present form apply, irrespective of whether the casting is poured on its flat with an area of 432 square inches; on edge with an area of 108 square inches, or on end with an area of 36 square inches? It does not seem logical that the same pouring time should apply in all cases.

W. Wallace McKaig.

Cumberland Steel Co.
Cumberland, Md.

The constant X in formula C referred to in Mr. McKaig's letter and used to calculate the area of the choke, has been given a tentative value of 0.24 for castings with a metal thickness of 1 inch. Whether this value is basically correct to secure minimum strain will require additional investigation. The problem presented of molding a given casting in three different positions, flat, on edge and on end, is very interesting. We have made a number of test castings under the conditions outlined and draw the following conclusions:

To insure the least strain, the mold should be poured in the same pouring time, irrespective of the position. The formulas contain factors which take into account the area or spread of the casting referred to by Mr. McKaig as the metal line. The factors for the various thicknesses of metal take care of the rate of chilling through the section of the casting. The square root function of casting weight takes care of the amount of metal to be cooled to solidification at a definite rate.

A casting poured on end may be poured much slower without cold shut than the same casing poured flat. The object is not to see how fast a casting can be poured, but now slowly it can be poured with safety.

H. W. Dietert.

Harry W. Dietert Co.
Detroit.

An Inspiration

To the Editors:

After reading the April 15 issue of The Foundry, I was so impressed, I immediately turned back the pages and read it again. It is one of the most inspiring articles I have ever read.

When through, I laid the paper aside and reflected on what had been said.

The first conclusion I reached was, with such a background, why haven't foundrymen more pride, and secondly, why should not this article be broadcast to every foundryman in an effort to arouse him to the importance of the part he plays in our modern complex life?

I believe the average foundryman since the beginning of the art (with the possible exception of statuary) has been indifferent to the two most important requisites of every business, namely quality and service and ignoring them the foundryman for centuries has been looked upon, one might say with contempt. Foundrymen have accepted, without resentment, any term of opprobrium that might be heaped upon them, assuming their industry could not be placed upon the same plane as any other business.

Unconsciously perhaps but nevertheless true, their attitude toward quality and service was reflected in the manner in which they sold their product.

At no time to my knowledge, have castings ever been sold on a basis which recognized that the industry was entitled to the same margin of manufacturing profit that industries, in which castings play a large part in the finished product, claim for themselves.

The foundrymen, seemingly content with what the user of castings was willing to pay, sold his product on a pound or ton basis regardless of cost and it has only been in recent years serious attempts have been made to establish the sales price of a casting on its cost and to insist upon a price commensurate with its value, or, in other words, applying the same principle the manufacturer of the finished machine applies to his product.

You may ask what this has to do with the article in The Feundry. The answer is with the marvelous outlets for castings and the dependence of other industries on foundries, why haven't the foundrymen been more aggressive and demanded for themselves what rightly belongs to them?

What you have had to say should be an inspiration to every red-blooded foundryman to take his coat off and cultivate the fields you have so clearly outlined. With the demand already existing for castings and potential markets to be developed, the foundryman can, with profit to himself and the world, occupy the niche he is entitled to in modern life.

W. H. Worrilow
President

Lebanon Steel Foundry
Lebanon, Pa.

W. J. Rainey Inc., Pittsburgh, has moved its offices from the Oliver building to room 613, Grant building.

Prevent Losses With Proper Gates and Risers

By Pat Dwyer

WITH the exception of a few foundries where gear wheels are gated between the arms, the universal custom in gray iron foundries is to pour the metal into molds for these and similar castings through gates on top of the hub. This is a logical arrangement since it insures a uniform distribution of the metal and a consequent uniform shrinkage and contraction from the circumference to the center.

In some instances the shape of the hub, the core or the condition of the cope does not favor the use of pop gates on the top of the hub. The necessity of providing large feeders may interfere with the use of one or more gates in the same area. In emergencies of this kind, and, of course, this applies to any casting with a hub in the center, the metal is introduced through a sprue in the center core connected at the bottom with suitable gate openings leading to the hub cavity in the mold.

Subject to considerable variation in size and shape, a minor factor so long as they deliver the metal with reasonable speed, the gates follow one of three general designs as illustrated in Figs. 57, 58 and 59.

The type of sprue and gate shown in Fig. 57 involves the use of two dry sand cores, one the usual center core for the hub containing the central sprue; the other, a cap core containing the gate passages. One of these cap cores with four passages is shown in Fig. 61. The size and number of passages naturally depend on the size of the casting and the volume of metal designed to be poured through them.

Where the drag part of the mold is rolled over, the cap core is adjusted in place over the drag print on the hub of the wheel pattern before the drag is filled with sand. Where the bedding-in process is followed, the cap core is wedged up against the bottom of the pattern hub and held there until the sand has been rammed under it. The wedges then may, or may not, be removed, depending usually on the personal inclination of the molder and, in some instances, on the available stock of wedges. Where wedges are scarce, they appreciate in value, like any other commodity. On large jobs the wedges should be removed, if

Use Strainer Gates

USED with discretion and the observance of proper precaution in the character of the sand and method of venting, a strainer gate with the sprue in the center of the core and the gate passages at the bottom, presents certain advantages for delivering molten metal to gear wheels and other types of castings with central hubs. The method is not recommended for general adoption. Under certain conditions this type of gate is responsible for defects in the casting that in many instances are laid to other causes. In practically all types of skimmer and strainer gates and runners, advantage is taken of the fact that a difference in specific gravity exists between molten iron and foreign inclusions. Also that these foreign materials, slush, slag or sand, show a tendency to stick to the surface of any sand with which they come into contact.

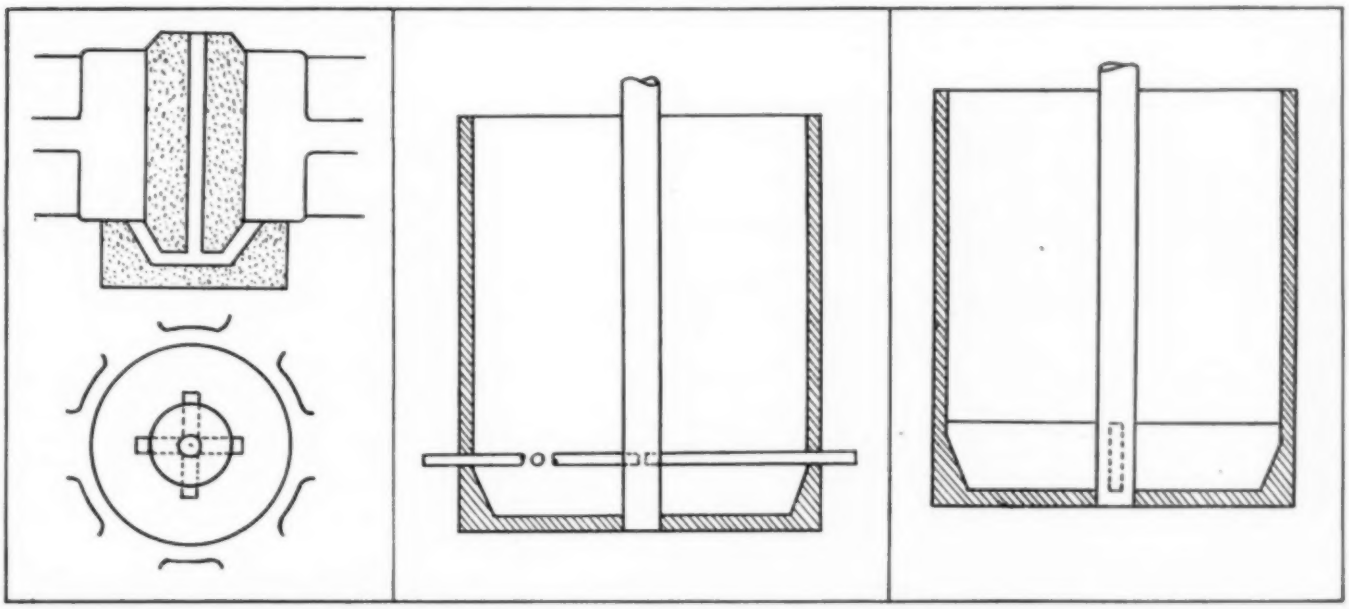


Fig. 57 (Left)—Application of Bottom Gate To Wheel Hub. Fig. 58 (Center)—Corebox for Hub Core Containing Bottom Gates. Fig. 59 (Right)—Same as Fig. 58 with Exception That Gates Are Thin and Rectangular Instead of Circular in Cross Section, also They Remain Permanently in the Corebox

for no other reason than to prevent them from contaminating the sand with ashes and charcoal as a result of the heat from the casting.

Whether the pattern is rolled over or bedded in, the net result is the same so far as the appearance of the mold is concerned. Thus in Fig. 57 a sectional view of the hub is shown with the center core resting in the cap or gate core. From the runner basin (not shown) on top of the cope, the iron flows down the central sprue into the four lateral passages, covered by the print part of the central core. The metal rises through four equally spaced gates. Three sides of each gate are formed in the sand of the cap core. The fourth side is formed by the tapered, print end of the center core.

Unless proper care is exercised in the preparation of the center core, this type of gate and runner may prove a prolific cause of trouble through defective castings. The aggravating feature of these defects, blowholes, segregation and shrink holes, is that they are of an ambiguous character and may be due to one or to a combination of several causes.

On account of the severe service to which the center core is subjected, a column of molten metal on the inside and surrounded by molten metal on the outside, the vent must escape with more than the usual speed. Provision for this contingency is found in a core sand mixture that shows a maximum of permeability. Usually this means a sand coarser than that in common use, bonded with a minimum amount of binder and dried thoroughly.

Where the vent cannot escape with more than usual facility from one of these cores, it will cause the metal to boil in the vicinity. Blacking and sand will flake from the face of the core and the resulting casting will show dirty areas on top of the hub,

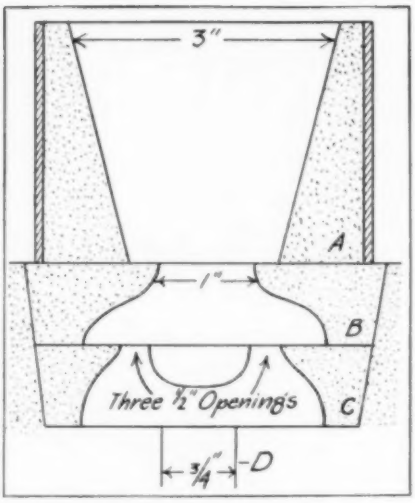


Fig. 60—Example of Combined Pouring Head and Skim Gate

shrunken spots on top and in the bore and blowholes everywhere.

Under certain conditions and with the observance of proper precautions the foregoing type of gate may be employed satisfactorily. However, due to the element of risk involved, it is not recommended for ordinary use. The cap or gate core presents no particular hazard so long as it conforms to ordinary requirements of strength, permeability, shape and size.

Another Method Favored

However, it does represent an item in the total molding cost and for that reason the gating system illustrated in Figs. 58 and 59 is favored where circumstances suggest the use of a sprue through the center core. In Fig. 58 the center sprue and lateral gate openings are made in the manner described in No. 11 of this series, which was presented in the June 15 issue on page 41. Usually the wood or steel devices employed for forming the sprue and gate openings are not removed until after the corebox has been inverted on a plate.

The foregoing applies to a one-piece corebox. Where the box is split, it may be removed laterally from the core in two sections and naturally the various loose devices are withdrawn before the support of the corebox is taken from the core. The split corebox is open at both ends and therefore need not be inverted to remove the core.

A slight variation in the manner of forming the gate openings is shown in Fig. 59. A thin wood or metal cross is attached to the bottom of the corebox and the end of the core appears as in Fig. 62 after the corebox is removed. As previously stated, the number and dimensions of the gates may be varied to meet requirements.

It will be noted here that only part of each gate is available for delivering the metal to the hub. The remainder of the gate passage is located below the level of the hub bottom and in foundry parlance, is shut off in the core print. Practically the only advantage of this type of core is that the wood or metal part or parts for forming the gates, remain in the main corebox, instead of having to be reset and removed before and after each core is made. This type of corebox may be employed with or without a bottom. Manifestly, it must be placed in a position opposite to that shown in Fig. 59 before the gate device can be removed from the sand. The corebox with a bottom is filled and rammed in the position shown and then inverted. The corebox without a bottom is filled and rammed in an inverted position, that is with the cross or other form of gate device in the top end.

A compact, simple skimming device, one that involves little expense either in preparation or application, a device that functions in a highly satisfactory manner is shown in Fig. 60. The upper part is green sand rammed inside

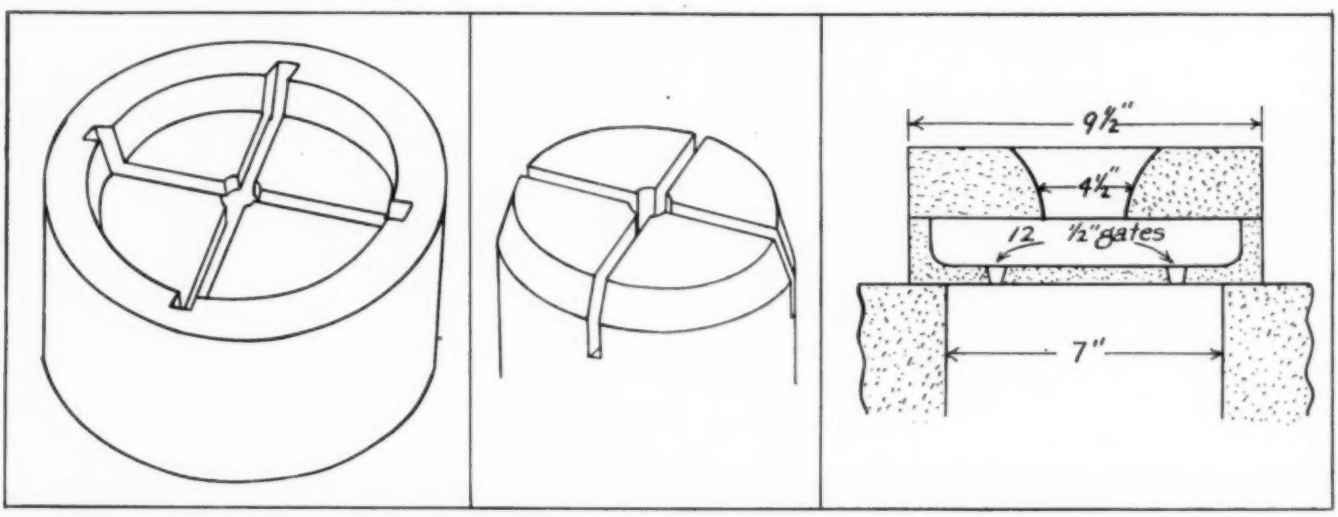


Fig. 61 (Left)—Four Branch Gate Is Formed in Socket Core in Bottom of Hub. Fig. 62 (Center)—Four Branch Gate Formed in Bottom Print End of Hub Core. Fig. 63 (Right)—Combined Pouring Head and Skim Gate Applicable to Spindles, Some Types of Rolls and Other Castings of Similar Character

a small steel or cast iron ring. Several alternative methods are available for preparing this device. The method illustrated in Fig. 60 is simple and effective. The upper part may be a green sand pouring cup rammed on a cone block, or it may be made as a dry sand core. Both these methods

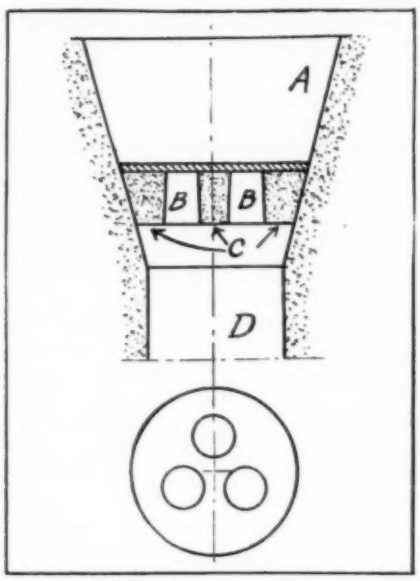


Fig. 64—Perforated Skimmer Core Is Dropped into a Tapered Green Sand Pouring Head

have been touched upon previously. The two parts *B* and *C*, small dry sand cores, are made and dried separately and may be placed in the cavity prepared for them in the top of the cope, in the same manner. However, they are handled more conveniently as a unit and for that reason, usually are pasted together.

Both cores are tapered on the outside in such a manner that when the cores are assembled as a unit, the tapered line is continuous. The dimensions given are suitable for the usual run of castings made on the bench and side floor, that is castings ranging in weight from 10 to 100 pounds. The same general design may be expanded and adapted to suit larger castings. A circular block, tapered at the sides and with a hole in the center is rapped down in the soft sand in the cope surrounding the sprue stick. Stick and block then are removed and the united core is dropped into place. The green sand or dry sand pouring cup is adjusted in place and the device is complete and ready for service.

In this, as in practically all types of skimmer and strainer gates and runners, advantage is taken of: 1—The difference in specific gravity between the molten iron and foreign inclusions and 2—The attraction of cohesion which holds foreign material in contact with sand of a mold or core.

Each time the molten iron enters a narrow passage and then is allowed to expand in a comparatively large chamber, some of the foreign material separates from the iron and adheres to the walls of the chamber. Thus in the strainer device shown in Fig. 60 the iron flows from the pouring cup through a 1-inch passage into the chamber *B*. Here the flow of metal is changed to a horizontal direction with any inclusions or lighter material floating on the top. The cleaned or partly cleaned iron sinks through a number of small openings (three in this particular instance) into another comparatively large horizontal chamber. Foreign material, slush, slag or sand is carried to the confining wall of the chamber *C* while the purified metal flows down the ¾-inch sprue *D* direct to the casting, or, to a runner which supplies one or more gates at the joint line or elsewhere.

An adaptation of the same idea is shown in Fig. 63 as applied to a cast iron spindle for a rolling mill train. This type of casting sometimes is molded horizontally from a split pattern and the danger always is present that a slight shift in closing the cope over the drag may render the casting unfit for use. By using a solid pattern or by fastening the two halves of a split pattern together and then molding the unit on end, all danger of a shift is obviated.

The gating design shown in Fig. 63 simplifies the molding to a considerable extent and requires a smaller amount of metal than any other practical method. Elimination of a long upright sprue and a bottom gate enables the molder to place the pattern in a smaller flask with a consequent reduction in the amount of sand to be handled.

On account of the shape of the casting and the method of introducing the molten metal at the top, solidification begins at the bottom and progresses gradually upward in a series of horizontal planes that merge into each other. The top metal is the last to freeze and since it has received a supply of hot metal from the many gates over the surface, it will sink uniformly in response to the contraction pull from the bottom. As a result no sink head is required and the small gate stumps, if any remain after knocking off the metal in the pouring cup and secondary basin, are removed easily.

In this as in the device shown in Fig. 60, the upper part may be formed either in green or dry sand, with the opening either in the center or nearer the side. The second or lower part is a dry sand core which takes the place of a cope. The chamber is 7 inches in diameter, the same as the casting, and is pierced with 12 tapered, ½-inch gate openings on a 5-inch diameter circle.

Probably the simplest example of the application of a strainer is shown in Fig. 64. This is a small perforated core dropped into the top of the sprue. It is tapered on the perimiter to correspond with the taper of the upper part of the sprue. Consequently the farther down it is pushed, the more tightly it fits. Thus the stream of metal falling on top, only wedges the core more firmly in place. A small disk of tin or cardboard is placed over the gate openings to catch and retard the first dash of metal from the ladle. By the time the tin or cardboard is melted or burned, the pouring cup is filled to the top and any dirt present, is floating at a safe distance from the small gates through which the clean iron is flowing into the mold.

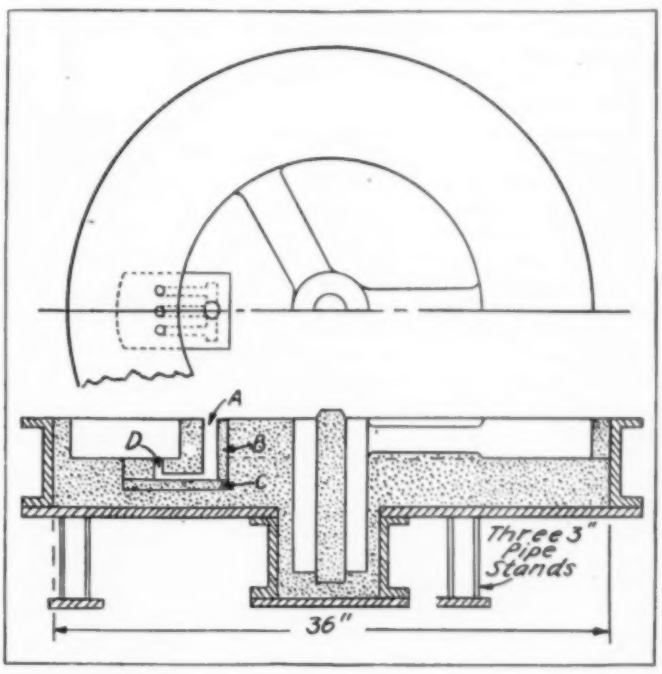


Fig. 65—Plan and Section of Core Strainer Gate Applied To the Under Side of a Friction Disk Casting

Under the old Guild system, the term journeyman was invented to designate a man who had served a defi-

nite period of apprenticeship, usually 7 years, at a given trade and who then was considered competent to handle any job that came his way.

In many instances, urged by curiosity, ambition or just plain wanderlust, he set out upon and continued his travels, voluntarily; but in the majority of instances he became a journeyman, in the literal sense.

Whatever the reason, the fact remains that molders moved around to a considerable extent and served as carriers of information. They acquired and dispensed knowledge with equal facility and this is particularly true in regard to shop kinks, those happy little inspirations that make for ease of operation and improved product. The habit still continues. Men still continue to *hit the road.*

Change Is Gradual

As a result of this gradual evolution it is impossible at this time to set a definite date for the introduction of many features that now are regarded as standard practice, or to assign credit to any individual for their invention.

Method adopted for pouring the friction disk casting shown in Fig. 65 is a case in point. This casting was machined to present a perfectly clean, smooth face on both sides and several types of gates were tried with unsatisfactory results before the gate shown in the illustration was adopted. This gate remained in service until the pattern became obsolete. A small pop riser indicated when the mold was filled, but no other riser or feeder was attached to the casting.

It will be noted that this gating system includes features from several types and is based on the theory, discussed in a former article, that slow pouring is conducive to clean and solid castings. The casting weighed approximately 400 pounds and the metal entered through three ½-inch diameter gates on the bottom. These in turn were fed by three horizontal branches leading to a transverse runner located under a sprue 1½ inches in diameter.

Sprue, runner and gates were formed in a dry sand core block. The block was made in two parts and dried. The two parts were pasted before the core was placed in position on the pattern in the flask. The bottom part *C* might have been laid on loosely without affecting the utility of the device, but the pasted core served as an insurance against displacement during the ramming process. A small runner basin on top of the cope conducted the metal to an upright sprue coinciding at the joint line with the sprue *A* in the core.

This is the twelfth of a series of articles dealing with the various types of gates and risers used in the foundry industry. The thirteenth installment will appear in an early issue.—THE EDITORS.

Betty Lamp Is Placed in New York Museum

An interesting example of foundry craftsmanship and perhaps an even more remarkable example of the enduring qualities of cast iron, are shown in a *Betty* lamp recently placed with the Museum of Science and Industry, New York. The lamp was presented by E. E. Lord, Killingworth, Conn., for many years foundry superintendent for Sargent & Co., New Haven, Conn.

The Prong at the Right Was Used as a Pick for Trimming the Wick

This particular lamp, shown in the accompanying illustration, was the cabin lamp of the good ship ELIZABETH AND ANN, owned and skippered by Captain William Lord, a direct ancestor of E. E. Lord. Captain, vessel and lamp arrived in Dorchester, Mass., in the year 1635, from which it is apparent that the lamp, the only survivor of the trio, is approximately 300 years old. It still is complete with the exception of a small swinging cover for the opening on top. A small hole on top indicates the presence at one time of the pin for a small swinging cover designed to cover the opening. The lamp was designed for burning whale oil or practically any other form of vegetable or animal oil. The thin, graceful body, approximately 1/16-inch thick, would tax the skill and ingenuity of a highly efficient modern foundryman to duplicate.

Contemporary evidence seems to show that the Dutch enjoyed a monopoly in hollow ware castings in the seventeenth century. The first lamps used in the newly planted Plymouth Colony in New England were made in Holland and were known among the English emigrants as Betty lamps, an easy Anglisation of the German *besser* (better). The few lamps that the Pilgrim fathers brought with them on the Mayflower were in that class. Some were forged, but the majority were cast iron, as in the example shown.

The earliest type was known as the open Betty, or slot lamp. This was followed by the Betty with a top, in which one part was formed as a hinged lid. The wick was supported on an angular half round iron secured to the inside bottom of the lamp. The upright forged strap at the back served for a handle. It was bedded in the casting at the lower end and was provided with a forged eye at the upper end, by which it might be suspended from a twisted iron bar. A short sharpened piece of iron welded to the upper end of the bar provided a convenient means of suspending the lamp from a beam, the top of a high rush bottom chair or a crevice in the wall or the sides of the great open fire place.

The body of the lamp usually was pear shaped, flat on the top and bottom. Occasionally a lamp was made in brass, but only rarely was any attempt made at ornamentation. These lamps were in use in some parts of New England as late as 1790. Prior to 1680 all lamps were imported. In 1680 an ingenious tinsmith of Newbury, Mass., began the manufacture of tin Betty lamps. After Newburyport was separated from Newbury, these were known as Newburyport Bettys. Later the lamps were made in Rivermouth, afterward known as Portsmouth, N. H., and were known as Portsmouth Bettys.

Officers Are Elected

At the organization meeting of the board of directors of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., held recently, the following men were elected officers of the company: A. W. Robertson, chairman of the board; F. A. Merrick, president; J. S. Tritle, vice president in charge of manufacturing; S. M. Kintner, vice president in charge of engineering; W. S. Rugg, vice president in charge of sales; L. A. Osborne, H. P. Davis, H. D. Schute, J. S. Bennett, H. T. Herr, Walter Cray, T. P. Gaylord and Harold Smith, vice presidents. C. H. Terry was elected an honorary vice president and E. M. Herr was re-elected vice chairman.

Cast Crankshafts *Replace* Forgings

By H. M. Heyn

Fig. 1—Castings Are Loaded on Trays and Placed on the Movable Furnace Hearth

CRANKSHAFTS, connecting rods, etc., have been made exclusively by the hot forging process for many years. A distinct departure from that time honored method has been made by at least one manufacturer of those items, and a materially better product has resulted.

A steel casting made of a special analysis alloy steel now is used for that purpose. A complicated and precise, triple heat treatment, imparts better physical properties to the casting, than can be obtained with forging and heat treating. By using castings it has been possible to redesign the previously mentioned parts so as to increase the strength at the weak points and lighten the structure as a whole. Furthermore, with the new designs, the castings were found to be better adapted to their various uses. Redesign was not possible in the forging process.

Pioneers Field

The Industrial Steel Casting Co., Toledo, O., has pioneered this field and is making cast crankshafts and connecting rods successfully for two of the world's largest manufacturers of pumps. A nickel manganese steel is used. Two specimens investigated had the following analyses:

Specimen Number	X-18	X-19
Carbon	0.344	0.340
Manganese	1.61	1.67
Silicon	0.69	0.61
Phosphorus	0.034	0.037
Sulphur	0.039	0.040
Nickel	0.73	0.70

The castings are given a special heat treatment that was developed in the company's research laboratory, as was the alloy steel. It is divided into three distinct treatments. All temperature and heating periods must be held within extremely narrow limits. This particular alloy steel lends itself readily to different heat treatments and the physical properties of two typical specimens are as follows:

Specimen Number	X-18	X-19
Yield Point	67,500	51,000
Ultimate Strength	101,750	90,000
Elongation in 2 inches	22.6	28.5
Reduction of Area	53.5	41.5
Brinell	192	187

The quality of the castings made by the Industrial Steel Casting Co. is maintained by sand, chemical, physical and micrographic laboratories, which control the various stages and processes of manufacture from raw material to the finished product. Research is carried on continually by the staffs of these laboratories.

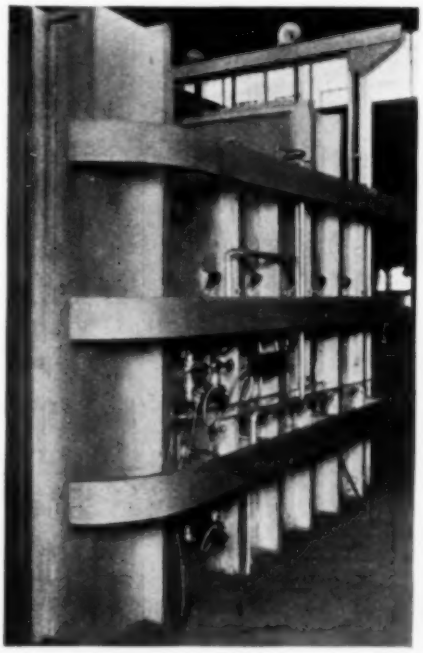


Fig. 2—Burners Are Controlled Automatically

Carefully kept records of the history of every casting enables the clients of that company to trace each item to the specific heat from which it was produced. The record starts with the details of the heat, the chemical and physical properties, and the microphotographs of the grain structure. All tests are made before the castings are shipped. The record accompanying each shipment of castings is a feature of the foundry and consists of a card bearing analysis, heat number, and photomicrographs of the grain structure.

Three Furnaces Used

Three furnaces are used to heat treat the casting. Each furnace is heated with a different fuel, namely, gas, oil, and electricity. The furnaces are of the car type, with the same brick and steel construction, but with different capacities. The gas furnace holds a charge of 12 tons; the oil, 8 tons; and the electric, 5 tons. The gas fired furnace was designed and built by the Surface Combustion Co., Toledo, O. Outside furnace dimensions are 18 feet long, 10 feet wide and 10 feet high. It is equipped with a single counter weighted door in front. The tracks on which the car operates are laid into the furnace through this door. The car is pulled in and out by an overhead crane and cable. The car top, which forms the hearth, is provided with a sand seal, so that the

heat of the furnace cannot penetrate below to the trucks. The compartment which contains the trucks is open in front for the free circulation of cold air from the outside, to eliminate heat from radiation. Twelve two-stage, high pressure, velocity type, gas burners are located along each side. Half of these are placed well down close to the hearth and the others in the upper portion of the walls. This is claimed to give uniformity in heat distribution.

Burners are manifolded to venturi type inspirators. Gas is furnished at a pressure of 10 pounds per square inch, and inspirates air for combustion. This setup permits any ratio of gas and air, so that the furnace atmosphere may be regulated to suit the circumstances by a single valve. Once set, this ratio is maintained automatically regardless of the volume of combustible mixture passing through the burner ports.

The furnace is equipped with two automatic temperature controls, connected with motor operated valves in the gas supply lines and two thermocouples in the heating chamber, one extending into the charge from the roof of the furnace, the other into the center of the load from the side. Valves are of the on and off type. When the temperature runs above the degree set on the control instrument, the valves automatically shut off the gas supply, and conversely, when the heat drops below this point, they open again. Temperature control instruments also record and operate between temperatures of plus and minus 5 degrees Fahr.

The waste products of combustion are vented through a series of flues built into the walls of the furnace. The flues terminate at the two main flues. Flues have motor operated dampers, which close automatically when the burners are shut off. That prevents infiltration of cold air to upset the heat cycle and atmosphere.

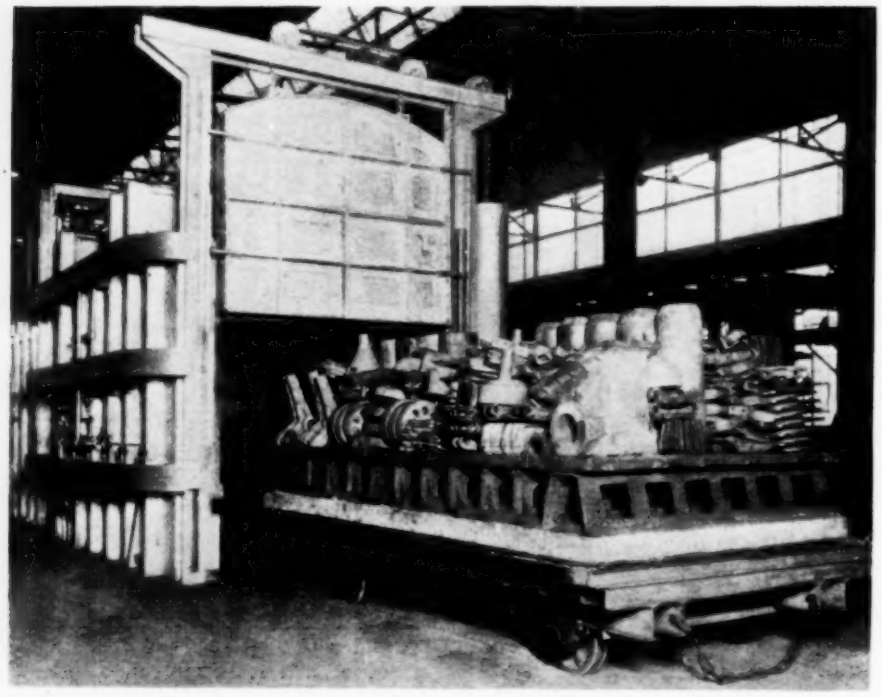


Fig. 3—Castings on the Brick Hearth Support the Trays Containing the Castings To Be Heat Treated

Will Hold Examination

United States civil service commission, Washington, will receive applications for the position of foundry superintendent to fill vacancies in the bureau of prisons, department of justice, at Chillicothe, O., and elsewhere. The positions will be awarded after a competitive examination and applications must be on file with the U. S. civil service commission, Washington, not later than July 21, 1931. Entrance salary is $3200 per year.

Competitors will be rated on practical trade questions and on their experience and training. Applicants must have completed an apprenticeship as molder or coremaker or must have had 4 years of equivalent experience in such trade. In addition, applicants must have had at least 2 years of responsible supervisory experience over general foundry operations, including melting, molding, coremaking, selection or purchase of sands, and cleaning and annealing of castings.

Full information may be obtained by addressing the secretary of the United States civil service board of examiners at the post office or customhouse in any city or the United States Civil service commission, Washington.

International Meeting Planned for Milan

An international convention and exhibit covering foundry subjects and participated in by various European foundry organizations will be held in Milan, Italy, during September. The exhibition which will take place in the machinery hall of the Milan Sample Fair will be open from Sept. 12 to 27. European foundry associations and organizations are participating and American manufacturers of equipment and supplies have been invited to exhibit.

The technical sessions will be held during the week of Sept. 13 followed by organized visits to foundries in the vicinity of Milan and later by a tour including Turin, Genoa and Rome. European foundry associations are participating actively in the congress and the American Foundrymen's association has been invited to contribute an exchange paper to the meeting.

Transactions Published

The American Foundrymen's association, 222 West Adams street, Chicago, has issued Vol. XXXVIII, of the *Transactions* of the society, edited by Robert E. Kennedy, technical secretary, of the association. The book contains the proceedings of the thirty-fourth annual convention of the society, proceedings of the annual banquet, reports of various committees and executives and minutes of the meetings of the board of directors. The major portion of the volume is devoted to papers presented at the various sessions of the convention and reports of the joint committees with other societies. Discussions, both oral and written, which followed the presentation of the papers, is given. Papers, reports and discussions, should be of interest to foundrymen in all branches of the industry. Copies of the *Transactions* may be obtained from the American Foundrymen's association, 222 West Adams street, $8.00 to those who are not members of the association.

Makes Safety Record

The foundry department, Youngstown Sheet & Tube Co., Indiana Harbor Works, East Chicago, Ind., recently completed 1581 days without an accident. The company operates a foundry for casting large floor plates, soaking pit doors, cinder and slag ladles and other heavy castings. In addition, it operates a small cupola for melting brass for bearings and other castings. The department employs 25 men. In 1928, the department worked 30,000 hours, in 1929, 75,000 hours and in 1930 over 42,000 hours a total of over 147,000 hours.

The FOUNDRY Family Photograph Album

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Upper Left

F. A. EBELING
W. W. Sly Mfg. Co., Cleveland

Upper Right

J. H. REDHEAD
Lake City Malleable Co., Cleveland

Lower Left

E. C. HYDE
California Foundry Co., Los Angeles, Calif.

Lower Right

BRADLEY STOUGHTON
Lehigh University, Bethlehem, Pa.

DATA TO BE SUPPLIED BY CONSUMERS

Of Jobbing Castings

Inquiries from buyers of castings should give the following essential information which is common to gray iron, malleable iron, steel and nonferrous castings:

Metal specification.

Sample casting or detailed drawing.

If drawing is furnished, the actual weight of the castings should be given.

Number of pieces to be ordered of each pattern with delivery dates and schedules.

Description of available pattern equipment and its condition, indicating:

(a) Type of pattern:
- Loose (number of patterns)
- Gated (number on gate)
- Plated (number on plate)

(b) Material from which pattern is constructed:
- Wood
- Brass
- Aluminum
- White metal

(c) Kind and type of core boxes:
- Number of cores to each box
- Material from which core box is made
- Whether designed for core blowing machines
- Number and kind of core dryers

If no pattern is available, is foundry to make pattern at customer's expense? If foundry is not to make pattern, will it have the opportunity to suggest how the pattern should be made? If buyer is to furnish flasks, size, type and construction should be given.

Drawings should clearly indicate:

(a) Important dimensions, dimensions tolerances and machined surfaces with amount of finish to be allowed.

Abstracted from a report of the A. F. A. cost committee's subcommittee on formulating data which should be supplied when estimates are requested. Robert E. Belt, Malleable Iron Research institute, Cleveland, is chairman of the subcommittee.

(*Concluded on Data Sheet No.* 868)

DATA TO BE SUPPLIED BY CONSUMERS

Of Jobbing Castings

(*Concluded from Data Sheet No.* 867)

(b) Special requirements, such as finish, testing, gaging, special tolerances, disk or special grinding, etc.

(c) Specific locations, if any, for symbol numbers, pattern numbers and trade marks, and whether raised or sunken symbols are preferred.

Description of the service or use of the casting. If the castings are to be subjected to pressure, give test to be made and methods of making.

State whether pound price or piece price is desired, and f.o.b. point.

Indicate any special crating, marking or packing.

In addition to the foregoing information which inquiries for castings should show, and which is considered common to all kinds of castings, the following information has special application to specific kinds of castings.

Gray Iron

Indicate special treatment, if any, such as sandblasting, pickling, annealing, heat treating, normalizing, japanning, painting, enameling, polishing, etc.

Malleable Iron

Are castings to receive any special finish, such as for galvanizing, sherardizing, plating, etc.?

Are castings to receive special operations, such as straightening, drilling, drifting?

Nonferrous

Physical and chemical specifications desired and tolerances permitted.

Are there any royalties to be paid by foundry?

Are castings to be heat treated, machined or to receive any special treatment such as for plating, etc.?

The Foundry Data Sheet, July 1, 1931

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

GRAY IRON

Possesses

Valuable Engineering Properties

TRUE gray irons do not contain free cementite, which is the hard, white component of chilled and mottled irons. However, under certain conditions gray iron castings may contain chilled edges, due to fins, improper analysis, and other causes which will be considered later. Free cementite or iron carbide, Fe_3C, occurs in relatively large formations as shown in Fig. 114. Its hardness is such that whenever it is encountered by regular tool steels or stellite, the tool usually is ruined. Except on edges and fins free cementite usually is not found in appreciable amounts where the combined carbon is under 0.8 or 0.9 per cent.

Factors Are Significant

It is obvious that the more significant factors influencing machinability and observable in the conventional analysis are percentages of combined carbon, phosphorus and total carbon . Under certain conditions the manganese-sulphur ratio has an important bearing and *alloy* elements also have an effect. Since the usual aim of the foundry metallurgist is to keep the elements silicon, carbon, manganese, phosphorus and sulphur constant, influence of other variables often is apparent in the changes in combined carbon. With other conditions equal, machinability generally is in inverse proportion to percentage combined carbon. That is, greater machinability is possible when combined carbon is low.

Hardness and machinability often are considered directly related. A hard iron is considered hard to machine and vice versa. In an earlier installment in this series the various hardness testing methods, were discussed, also the relation of the various hardness tests to other physical properties. It was shown that there is a general relationship for example between brinell hardness and tensile strength. Since tensile strength is related to machinability, in irons of somewhat similar analysis, so brinell hardness number variations in a given type of iron usually indicate differences in machinability.

However, as pointed out by Lowry, *Proceedings*, A.S.T.M. 1929, hardness cannot be regarded as a true indicator of machinability since it does not measure the abrasive quality of the material. Abrasive hardness such as imbedded sand, free carbides or phosphides is detrimental to machinability. Skin hardness, chilled edges and fins on a casting cause the abrasiveness to increase and thus detract from the machinability. Annealing especially over 950 degrees Fahr., higher silicon content, higher carbon content, the addition of nickel, titanium, or any other softening alloy react upon the hard substances with the exception of burned-in sands. Nickel particularly reduces the chilling action and thickness of the hard skin, thus reducing the difficulty of machining.

The relationship between tensile and machinability is shown clearly in Fig. 116. The iron had been kept on an excellent basis for high production machining during the first month. For various reasons the tensile strength in the test bar was increased as shown, without notices to the shop, but with tracers on various casting lots. It did not take long to find troubles arising from losses in tools, difficulty in maintaining cutting rates, etc. In that case, machining was on small castings made on a high production basis. In an ordinary jobbing shop the differences noted probably would have escaped detection.

Alloys Promote Graphitization

A great deal has been written about the use of alloys to promote machinability. Those alloys which promote graphitization, such as nickel, aluminum, etc. increase machinability while those which inhibit the disintegration of carbides, such as chromium, diminish machinability. Probably much of the nickel added to cast iron is wasted by using it in irons of already unsuitable analysis. However, there is no question that for many foundry conditions the use of nickel serves a useful purpose, and its high direct cost in many cases is offset by saving elsewhere. According to the

Considers Factors

THE foundry often occupies the unenviable role of being squeezed between two millstones; the machine shop demanding easy machining iron, and the engineering department requiring strong iron. Where strength is the prime requisite, the machine shop should correct its practice to handle the irons properly. However, in many instances it may be found that difficulty in machining is due to other factors than composition of the iron, and these are presented for consideration in this article.

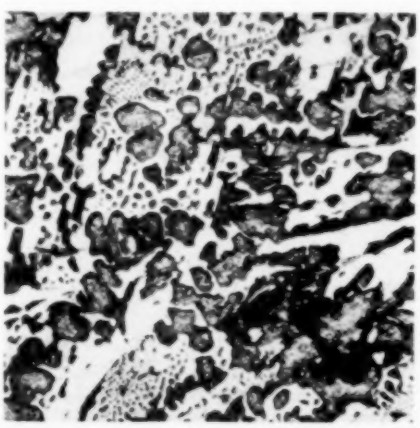


Fig. 114—Micrograph Showing Cementite (White Constituent), Etchant Picric Acid, 100 Diameters

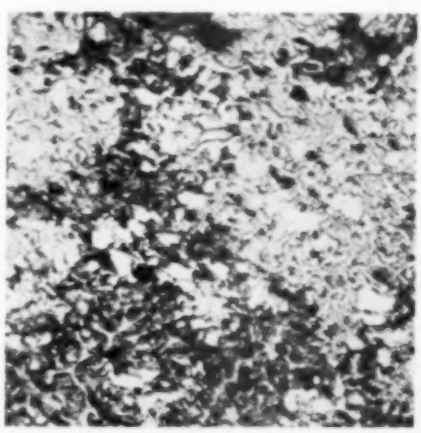


Fig. 115—Structure of Easy Machining Iron of Good Strength, Etchant Picric Acid, 100 Diameters

manufacturers' claims nickel increases machinability, hardness, and strength simultaneously. In many cases it does.

Nickel slows down in its graphitizing action when the combined carbon is under the eutectoid percentage. This helps in elimination of chilled spots, hard skin etc., without serious lowering in strength and promotes uniformity in hardness. It tends to sorbitize the pearlite. This makes the pearlite stronger and harder yet helps its machinability, due to breaking up of the cementite lamellae. It also is claimed that nickel tends to refine the graphite structure.

In many cases, especially in strong irons of types that tend toward hard spots and chilled edges, nickel may improve machinability hardness and strength simultaneously. The use of nickel also enables the use of some chromium, preventing its chilling effect and abetting its effect in strengthening the matrix. As summarized by Coyle, *Proceedings*, A.S.T.M. 1929,—"In many special cases alloys will appreciably aid machinability. This is particularly true in cases where chilled edges or corners are encountered in which instance the addition of a graphitizing element such as nickel will facilitate machinability by eliminating the chill."

Good Operation Necessary

Good cupola operation has a beneficial influence in obtaining uniformity in machinability. Careful selection of raw materials, correct charging, good hot operation, proper slagging with correct balance between iron charge, coke charge, and quantity of air all play their part in enabling the founder to furnish the most uniform and machinable castings. Uniformity is most important. Machinability is determined by the hardest castings, not by the softest. It is obvious that for a given physical specification the more uniform the iron, the higher the average strength can be maintained without serious variations on either the *hard* or *soft* side. A mixing ladle often is a dividend-paying investment.

Not only is the character of the iron coming from the cupola affected by the more commonly recognized factors, but as pointed out by Boegehold and later by Crosby and Hambley, *Transactions*, A.F.A., March, 1930, even the humidity of the air blast has an effect on the chilling capacity, hence machinability characteristics of the iron. That relationship, according to Crosby and Hambley, is shown in Fig. 117. Unremitting attention to details is necessary for maintenance of high standards of quality and economy in machinability.

May Be Gray or White

Molding practice also plays an important part in obtaining uniform and good machinability. Quick handling of ladles and good pouring practice are factors. As a matter of fact certain critical types of castings from borderline mixtures can be made alternately gray or with chilled edges by variation in pouring. Wet molds often cause chill spots. Loose core prints, improperly clamped molds, and the like cause fins which often are chilled and cause plenty of trouble. Removing small castings from the sand too soon often hardens them. Pouring too hot in too open sand causes *burning-in* of sand, which ruins tools. Too small a finish allowance also causes the tool to *ride* on the hard, sandy surface and *burns up* the tool.

Cleaning, or fettling as the English call it, is a potential source of trouble. Sandy and scabby castings ruin tools. Sometimes tumbling merely burnishes over sandy surfaces, when blasting, by cutting off the sand, helps machinability. By the same token pickling in some cases may prove more effective than either sand blasting or tumbling. Rusting, which can be accelerated greatly by sprinkling with sal ammoniac, softens the surface scale. Those surface treatments, effective when cuts are shallow, are not so important when the cuts are deep.

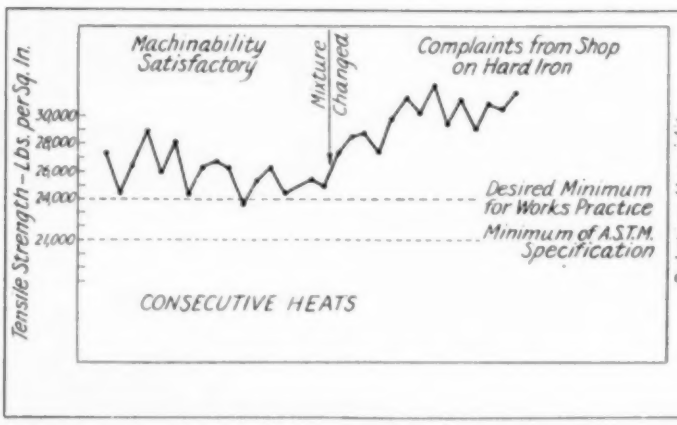
Annealing to produce graphitization, of course, increases machinability. In some cases the sacrifice in strength is overbalanced by the increase in machinability. Annealing or normalizing below the graphitizing range around 900 degrees Fahr. also is held to improve machining somewhat. It does relieve internal stresses, but the effect of this on machinability is problematical. To the author's mind the normalizing processes, usually conducted in an oxidizing atmosphere, soften the skin through the scaling and rusting, and further advantage is questionable.

The general influence of a number of factors on the machinability of gray iron have been discussed, yet in many cases the real troubles are not due metallurgy or foundry practice. Many difficulties blamed on the foundry can be traced elsewhere. Hard iron is a good alibi. The art of cutting metals involves many factors, of which the intrinsic machinability of the metal is but one. Poor tool material, improper heat treatment, incorrect grinding, poor setup, vibration in the machine tool, etc. are prolific sources of trouble. Oftentimes it is difficult to get to the true source of trouble.

Cooperation Is Essential

The human element cannot be overlooked. Most machinists are on a semipiece work, profit sharing, or bonus system. They want to make money. The production superintendent wants to make a good record. For most of them the iron cannot be too soft. They bring pressure to bear, they kick. This is but human nature. If the iron is not strong enough or is poor in wearing quality, that is not their lookout. The answer to this condition is firmness, tact, fairness and above all, co-operation. Foundry and shop must team together. Buck passing has no place in modern industry. Each man must do his part to the best of his ability. Since two minds are better than one, getting together is profitable to both.

It is too bad that there is no simple easy test to determine machina-



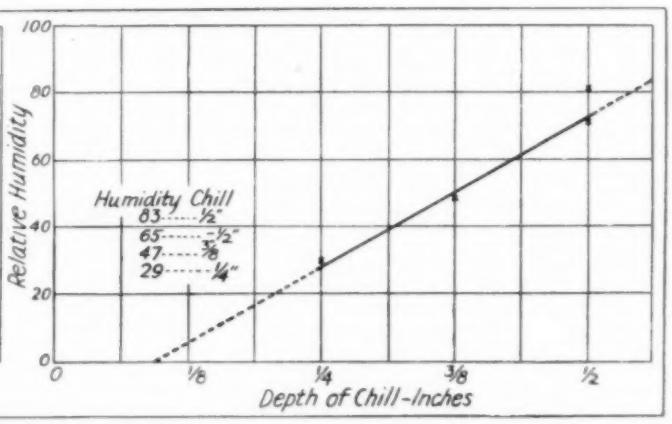


Fig. 116—*Effect of Change in the Tensile Strength on Machinability.* *Fig.* 117—*Curve Showing Relation Between Humidity and Chilling Characteristics of Gray Iron. High Humidity Gives Decreased Fluidity, Increased Hardness and Increased Depth of Chill*

bility. A reason for this is that machinability is not a simple property. Drilling, milling, lathe cuts, etc. each are different measures of machinability. Best machinability really means removal of metal at lowest overall cost. To illustrate, it is possible to speed some jobs up considerably, but tool breakdowns may be so increased that the gain on one hand is lost by the added expense on the other. Since the time of F. W. Taylor there have been many tests devised to measure machinability, and to date there has emerged no really satisfactory and simple general test. The overall cost of machining one type of iron compared to another remains the only accurate measuring stick.

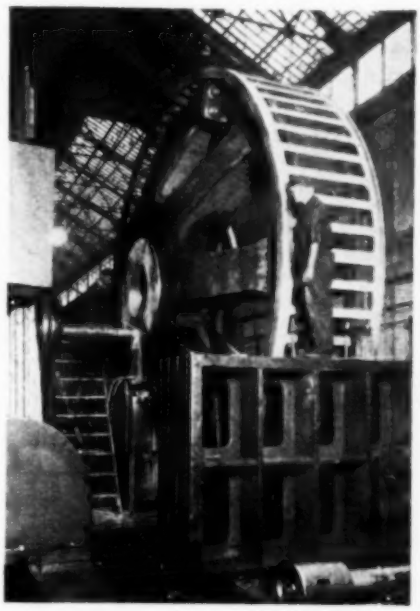
Squeezed Between Two Stones

As stated by Bornstein "The foundry finds itself squeezed by the engineering department on one side and the machine shop on the other; the engineer wants strong castings and the machine shop wants castings which are readily machinable." What can be done about it? When castings are made for severe engineering service it is obvious that good physical properties are imperative and the specifications must be adhered to rigidly. It usually is not particularly difficult to meet the physical specifications but to do this and maintain maximum machinability consistent with the specifications is a real problem. Yet, because of its economic importance it is a problem which cannot be ignored. Under such conditions employment of a skilled technical staff is more than desirable. Not only is detailed metallurgical knowledge necessary but this must be accompanied by ability to enlist co-operation and by good judgment or common sense.

The first step is to watch the machining operations, and to discover just what details are giving trouble. Castings which give trouble should be broken, and tested in various other ways, for example by filing, by Rockwell uniformity tests, by analyses and the like. If the trouble is due chilled spots ,care should be taken to eliminate all fins, see that molding sand is not too wet, etc. The remedies for burned-in sand, cold shuts, and similar surface defects lie in molding and pouring practice. Cupola operation and pouring practice should be checked with an optical pyrometer. The fluidity of the metal should be watched carefully to see that an excess of air is not causing oxidized, dead iron.

Granted that machine shop practice is good and that the troubles cannot be traced to details in foundry operation, the analysis and like factors, remain to be considered. Of course, if regular analysis and analyses of hard castings, makeup of charge, combined carbon in the check test bar, tensile strength, and similar check tests indicate that there has been no real change the trouble likely is elsewhere.

Let us assume that in spite of good foundry practice and uniformity of metal trouble still remains. One of two things is wrong. If it is the metal the troubles are likely to be general and a change in mixture may be necessary. If only certain castings cause trouble, it is a pretty good indication that the castings do not fit in well with the general run of designs, and it may pay to make special provisions for them or to send them elsewhere. Every jobbing shop has a variety of castings and mixtures necessarily are compromises. If the bulk of castings are perfectly satisfactory on all counts, it often is unwise to change the mixture to accommodate a few offenders. In such cases addition of a graphitizing element such as nickel to the ladle may turn the trick. If not, it probably will pay to farm the offenders out.



The Foundry Industry Has Contributed to the Development of the Production of Electricity by Water Power

On the other hand, if the trouble is general a change in mixture seems in order. Assuming always that we are working to definite minimum specifications, the first step is to see if these are being exceeded by too wide a margin. If so, a little lowering in strength plus renewed efforts to obtain uniformity likely will diminish the trouble. If the specifications are not being exceeded, efforts should be made to get the *abrasive* elements, like phosphorus, down as low as consistent with running the castings.

If necessary to get a more machinable iron of equal strength, raise the silicon and lower the carbon to produce a strong iron with a reasonably soft matrix. This job demands knowledge, skill, and care, and should be under the supervision of a skilled metallurgist.

Concluding, it must not be forgotten that an extra-strong, tough, high-test iron will not machine as readily as a lot of weak mush, and there are limits to what can be accomplished. The folly of the old time foundryman, raising machinability and lowering quality, should not be repeated.

This is the eighteenth article on the engineering properties of gray iron. The seventeenth article appeared in the June 1 issue, and the nineteenth will be presented in an early issue of THE FOUNDRY.

THE EDITORS

Huge Water-wheel Cast in Two Pieces

The foundry industry has played an important part in the development of water power for the production of electricity. It has supplied many castings that are incorporated in the various types of equipment used for that purpose. Recently the Union Electric Light & Power Co., began the construction of a hydroelectric development in the Osage river about 100 miles west of St. Louis to supply light and power to the St. Louis district. Part of the necessary equipment included six, 23,000 kilovolt-ampere, vertical, water-wheel generators, which were ordered from the Westinghouse Electric & Mfg. Co.

A part of one of the huge generators is shown in the accompanying illustration. It is a cast spider 4 feet thick, 20 feet in diameter and weighs 90,000 pounds. The spider was cast in two pieces. The arms droop downward from the hub, resembling an umbrella. That type therefore is known as an umbrella-type, vertical, water-wheel generator. It is interesting to note that the construction of the entire generator will require 9 months and about 200 men will work on it at various times.

Yearbook Is Issued

The fifth annual issue of the *Standards Yearbook* of the United States department of commerce recently was issued by the national bureau of standards. A picture of the standardization movement in various fields of industry conducted by national and international agencies is presented in the publication. The volume contains outlines of the standardization activities and accomplishments of not only the national bureau of standards and other agencies of the federal government but also of technical societies and trade associations. Among the special features included is a series of articles contributed by experts in the several fields of transport. The book is available in cloth binding from the superintendent of documents, Washington, for one dollar.

Control Temperature In Cupola Bronze Melting

By T. Mauland

SINCE the introduction of fixed carbon fuel several years ago, the cupola melting of bronze metals has been coming to the front. The brass foundry with which the author is connected has been melting bronze in a special cupola for the past 2½ years. This short article is intended to set forth briefly our experience and practice with that form of melting.

Fixed carbon fuel is a special form of pitch coke and is used in cupolas under license arrangement. The fuel runs 98 per cent and better in fixed carbon and is low in sulphur and ash, making it an ideal fuel for nonferrous cupola operation.

The cupola referred to in this article is of small diameter, 35½ inches, shell-lined down to 22½ inches. It is operated on low blast pressure and low air volume, using fixed carbon fuel. The metal and coke charges are weighed on a scale situated on the floor level near the cupola, and are elevated and dumped into the cupola by a mechanical charging arrangement having a skip hoist and operated from the floor level.

Use Monorail System

The molten metal is tapped into a 180-pound crucible hung on a trolley from an overhead monorail. This monorail connects with pouring cranes which serve all molding floors, and molten metal is taken from cupola to molds direct without transfer.

A platform is located on the charging door level. The operator ascends this platform occasionally to observe the progress of melting or to poke down the charge. Poking down the charge is necessary only when long gates or other bulky materials are used in the charge.

The cupola air blast system is equipped with a volume meter and pressure gage. The slag hole is located on the side of the cupola and the charging apparatus in the rear.

The section of the cupola from the bottom door to a foot or two above the melting zone is lined with a 2-inch monolithic silicon-carbide refractory backed by a course of firebrick and a course of sil-o-cel brick for insulation. Above the melting zone, ordinary firebrick is used for lining.

For the monolithic lining, from 400 to 550 pounds of silicon-carbide cement is required. This lining is good for 3 weeks or more, depending on the tonnage melted and the care taken in daily patching. The life of the firebrick and insulating brick backing is approximately one year.

Practice Described

SMALL cupolas operated on low blast pressure with a high fixed carbon fuel are being used to melt bronzes. The methods of operating that type of melting unit, as described in this article, are practiced in the Deering Works, International Harvester Co., Chicago, where the author is metallurgist. The article is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association.

Daily patching is done in the morning and requires 1 hour of labor. The bad spots in the lining are patched with silicon-carbide cement, requiring as a rule from 20 to 40 pounds. After the tap hole and breast are fixed, the bottom door is swung into place and secured.

The bottom door is lined permanently with firebrick. The space between the wall of the cupola and the firebrick of the bottom door partially is filled with molding sand and then a mixture of fireclay and ground firebrick. This is done through an opening in the back of the cupola. This opening then is closed from the outside by two cupola blocks.

The bed charge of coke is ignited and brought to incandescence by natural draft through the open tuyeres. The blast is put on a few minutes before the first metal is charged. Approximately 20 minutes later, the metal is ready to tap.

Two alloys generally are melted in this cupola, either the 85-5-5-5 or the 80-10-10 alloy, or both. When changing from one alloy to the other, all the metal in the cupola is melted and drained out before the second alloy is charged. We try, of course, to run on one alloy as long as foundry conditions will permit.

Metal charges usually consist of alloy ingots, returned scrap and sprue and returned borings. The metal charge varies with the class of castings made. When light castings are being produced on which there is considerable machining, the amount of borings returned and the amount of sprue are greater, and the proportion of these items used is higher.

When melting the 85-5-5-5 alloy, the principal loss is in zinc, with practically no loss in copper, lead and tin. The metal is brought to proper composition by the addition of from 1.50 to 2.50 per cent zinc to the crucible.

When melting the 80-10-10 alloy, the main loss is in lead, with a slight loss in tin and practically no loss in copper. The 80-10-10 alloy is brought to proper analysis by the addition of 1.00 to 2.00 per cent lead. The loss varies with the temperature of the metal and the length of time it is held in the cupola. An extremely hot metal held in the cupola for too long a time will show a higher loss than a medium temperature metal that is tapped promptly.

Zinc and Lead Volatilize

The loss of zinc and lead is apparently by volatilization rather than by oxidation. Our experience is that loss in melting is considerably less in the cupola than in open-flame furnaces.

A metal charge of 550 pounds is used and the cupola holds from two to three charges, depending on the bulkiness of the materials used. The bed charge consists of 200 pounds of coke, and the average weight of coke between charges is 34 pounds.

The amount of coke is decreased or increased according to temperature of metal desired. The cupola will melt about 10 tons per day and is operated by two men—the cupola

tender and the man making up the charges.

A large percentage of the castings produced consists of carburetor castings and bushings. Some of the carburetor castings are light and are poured from metal at a temperature as high as 2300 degrees Fahr.

Some of the advantages of cupola melting are: Rapid and economical melting; ease and ability to get hot metal; absence of heat and noise; absence of fumes (except when tapping); low melting loss; high quality of product and clean, solid metal; and ability to melt efficiently borings, turnings, spillings, skimmings, washings, insulated copper wire, etc.

The cupola is not recommended for melting high zinc alloys.

French Foundrymen Hold Meeting

THE tenth annual meeting of the Association Technique de Fonderie de Paris was held at the Ecole Nationale d'Arts et Metiers, Paris, May 20 and 21. M. Luc, director, government department of technical instruction, presided at the opening session and introduced Jules Cury, the incoming president of the French association. In his opening address, M. Luc emphasized the necessity of thorough and efficient methods of technical training for foundry workers, and mentioned that M. Cury was one of the leading promoters of that movement. A center of researches for the foundry industry has been organized and is nearing completion. Societe des Hauts-Forneaux de Saulnes has aided in the organization and has offered financial assistance and the use of the laboratories at the Saulnes works. This center of researches will be an independent organization, the sole object of which will be disinterested work which will prove profitable to the industry as a whole.

Thirteen papers were presented at the meeting, the majority of which were read and discussed during the technical sessions in the morning and afternoon of both days. Professor Portevin, president, international committee on cast-iron testing methods, presented the first paper on the program, entitled, "A Few Remarks Relative to Mechanical Tests of Cast-Iron." The paper deals particularly with the influence of speed in the shear test, the derivation of formulas, and the degree and index of homogeneity of cast iron.

Testing Methods Discussed

M. Le Thomas, president, French committee of cast-iron testing methods opened the discussion by pointing out that relations between the various characteristics such as those obtained by measuring tensile strength or by the shearing test, etc., are somewhat vague. J. Leonard, president, Belgian Technical Foundry association, mentioned some experiments made by Professor Thyssen, Liege, on the speed with which the effort is applied in the shearing test, and in which the figures did not reach the high levels given by Professor Portevin.

The next paper was presented by M. Hiernaux, director, Universite du Travail, Charleroi, Belgium, on "The Training of the Molder." M. Hiernaux gave a complete report on the schedule of studies which is applied at the university over a period of three years.

The afternoon session opened with the exchange paper of the Belgian Technical Foundry association, "Contraction in Pulleys and Fly-Wheels," which was presented by its president, J. Leonard. E. V. Ronceray said that the only general rule to be applied in the case of such pieces was to subject the casting to a stabilization treatment. This treatment consists in taking the casting as soon as it is solidified completely and cooling it slowly in a pit. M. Ronceray also pointed out that the use of high-duty cast iron is of practically no value if any internal stresses remain in the casting. M. Le Thomas mentioned that in certain cases the placing of nails, at the junction of the rim and the arms of the pulley had prevented the formation of cracks.

Opinions Differ on Scabs

M. Gasquard presented a paper on "Scabs in Castings." He mentioned the formation of two types of scabs, which, according to French nomenclature, are called *real* scabs and faulty scabs, each term being applied relative to the manner in which the sand has been displaced. The discussion on this paper revealed differences of opinion in regard to the particular case to which each term should apply. The session ended with a paper by V. Marteil, professor at the high school of foundry, entitled: "A Study of Core-Prints."

The second day's sessions opened with a paper by R. de Fleury, on "Security in the Use of Castings—the Part of Occult Factors of Instability in Manufacture—Concrete Examples Relative to Light Alloys. But Which Do Not Apply Necessarily to Such Alloys." This paper is of a theoretical nature. A paper on "Holding Furnaces in the Aluminum Foundry" then was presented by Pierre Girod, engineer, which compares the use of graphite crucibles and cast iron pots in the manufacture of chilled castings. The paper is divided into four parts: The study of hard grains, their causes and remedies; the use of graphite crucibles, the manner in which they are destroyed, and their influence on the formation of hard grains; the use of cast iron crucibles; and general conclusions.

P. L. Montupet, who presided over the session, opened the discussion by saying in aluminum, the oxides and the grains of graphite remain suspended in the metal, even after it has been agitated. He emphasized the necessity of thoroughly cleaning the crucibles each day. A speaker mentioned the use of pots of austenic cast iron, which is stable at a high temperature and which resists to oxidation. M. Le Thomas said that sufficient attention had not been given to the utilization of cast-iron which does not contain any additions of special metals such as nickel or chromium. It was his opinion that pots of perlitic cast-iron would be the most resisting. E. Durville, consulting engineer, Paris, stated that a slight agitation after the addition of some chloride of manganese, assists in forcing oxides and inclusions to rise to the top of the aluminum bath.

This paper was followed by the exchange paper of the American Foundrymen's association, entitled: "Measuring Molten Metal Temperatures in the Brass Foundry," by H. M. Saint John, chief metallurgist, Detroit Lubricator Co., Detroit, which was presented by V. Delport, European manager of THE FOUNDRY.

Uses Hot Metal

Discussion was opened by J. Derdinger, bronze founder and honorary president, syndicate of bronze founders, Paris. Referring to a passage in the paper in which the author states that "the present tendency among progressive foundrymen is to use the lowest possible pouring temperature, to get maximum soundness and strength," M. Derdinger stated that the advisability of pouring with hot or cold metal depends upon the thickness and weight of the casting, and that it is advisable to use hot metal to cast light brass castings. M. Le Thomas mentioned that he often had insisted on using pryometric methods is casting special brasses, and that in the case of high-resisting brasses, the metal should be poured at the lowest possible temperature. The discussion showed considerable differences of opinion on the advisability

of pouring the previously mentioned castings with hot or cold metal.

E. Moustacas and N. Merle, foundry proprietors, Paris, presented the next paper on "A Study of Brasses." In the discussion, M. Le Thomas emphasized the fact that tin should be considered as a fragile constituent in brasses. Referring to a passage in the authors' paper in which mention was made of certain cracks in castings, and in which the authors suggested that these cracks were due to an hereditary defect in the metal, M. de Leris pointed out that these defects only appear after usage, and that they are due to stress through cold-working.

In the afternoon, Mr. Girault presented a contribution on "Contraction in Iron Castings." This paper is a complete study of contraction and permanent deformations in iron castings. The conclusions of the study are: Cast-iron is malleable at a temperature of between 600 and 900 degrees Cent.; cast-iron is susceptible to elastic deformation at a temperature around 100 degrees Cent., in a casting with a variety of thicknesses, the position and the shape of the gate have considerable influence on the permanent deformations which will result later; the method of pouring a casting with various thicknesses at the thinnest parts is barely sufficient to prevent the bad effects of contraction.

The exchange paper of the Institute of British Foundrymen was presented by J. H. D. Bradshaw, Bradley & Foster, Ltd., Darlaston, England. The subject of the paper was "The Enamelling of Cast-Iron." H. Magdelenat presided over the session. A speaker in discussing the paper, emphasized the importance of the preparation of the casting before it is heated for the application of the enamel. He also said that it is important that the castings should be heated gradually. M. Flour presented a paper entitled: "Remarks on a Few Phenomena of Solidification in the Steel Foundry," and the meeting ended with the presentation of the report of the French committee on cast-iron testing methods by A. Le Thomas and president of the committee, P. Nicolau.

Reviewing New Books

Worth While Literature Covering Numerous Problems Pertaining To Foundry Practice, Management, Merchandising and Research

Identification of Minerals

Spectrum Analysis in Mineralogy, by A. A. Fitch, paper, 52 pages, 6¼ x 9¾ inches, published by Adam Hilger Ltd., London, England, and supplied by THE FOUNDRY, Cleveland, for 75 cents and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster, for 7s 9d, postage extra.

While spectrum analysis is becoming adopted rapidly as an additional means for the identification of mineral species and for investigating their chemical composition, there has not been any convenient summary of the technique to be employed or of the results obtained by the various methods. That lack is filled with the publication of this volume which gives such information as technique, qualitative and quantitative analysis of minerals, analysis of mineral concentrates, rocks, and meteorites, etc.

Discusses Malleable Iron

Der Temperguss, by E. Schuez and R. Stotz, imitation leather, 390 pages, 6¼ x 9¼ inches, published by Julius Springer, Berlin, Germany, and supplied by THE FOUNDRY, Cleveland, for $10, and in London by the Penton Publishing Co. Ltd., 416-17 Caxton House, Westminster.

Malleable foundrymen familiar with German will find this volume an excellent treatise on the subject of malleable cast iron. It not only covers the production of white-heart malleable cast iron, but also includes the manufacture of black-heart malleable. The first chapter is devoted to a historical account, and is followed by a chapter on the scientific aspects of malleable cast iron. Chapter III deals with technology and describes the raw melting materials and the several types of melting units which include the crucible, cupola, air furnace, open-hearth furnace, the electric furnace, duplex and triplex melting. The section on molding covers sand preparation, core making, mold and pouring technique, and pattern design. Methods of cleaning the castings include descriptions of tumbling, sandblasting, and grinding machinery.

The section on annealing covers annealing pots, packing material, temperature indicators, annealing ovens and methods, annealing defects and costs. That is followed by a short description of final finishing methods. The various properties of malleable cast iron including strength, electrical and chemical properties are given in another section. Information also is given on the effect of the elements on the properties. Chapter VI describes malleable iron foundry layouts, and Chapter V is devoted to cost accounting. An appendix contains a short history of malleable founding in Belgium, a register of malleable iron foundries on the Continent, and a bibliography of literature on malleable cast iron.

Studies Group Incentives

Group Incentives, by C. C. Balderston; cloth 6 x 9 inches, 171 pages, published by University of Pennsylvania Press, and supplied by THE FOUNDRY for $2.50 plus 15 cents postage and in London by the Penton Publishing Co., Ltd., 416-17 Caxton House, Westminster, for 12s 6d plus postage.

The author has made a careful study of group-incentive, wage-payment plans through correspondence and visits to outstanding industrial organizations in the United States, and presents an analysis of his findings in the field. Methods by which group incentives have been adapted to varying conditions and comparison and appraisal of the methods are considered in a thorough, academic manner. Topics presented by the author include: composition of the group; basis for paying extra-compensation; distribution of earnings; protection of employes; and, social problems raised by group incentives. Labor efficiency charts and tables involving a comparison of the well-known bonus systems are a part of the chapter on distribution of group earnings. The appendix of text, which summarizes information gathered in the field, is a most valuable part of the work. The results obtained by group incentives, as stated by executives of the industries in question, are compared to day-work results and individual, piece-work results. The advantages of the group plan for payment of indirect labor and the savings in clerical costs brought about by its use are evident from examples in industry. Digests of group plans as used by some 21 companies are another valuable feature.

Hold Golf Tournament

Foundrymen and foundry supply representatives of the Chicago district and surrounding territory, representing 27 firms, held an outing, golf tournament and evening dinner on July 11 at the Gleneagle Country club near Chicago. A. W. Lemme, Elizabeth Street Foundry Co., Chicago, president of the Chicago chapter of the Gray Iron institute, presided at the dinner and appointed a committee to organize a permanent annual outing for Chicago foundry representatives, the first to be held next October. This committee consists of John Gellert, Nichols-Straight Foundry Co.; H. E. Risher, Risher Fire Brick Co., and Charles Kawin, Charles C. Kawin Co.

Questions & Answers on FOUNDRY PRACTICE

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall
Cast Steel

H. A. Schwartz
Malleable Cast Iron

J. W. Bolton
Gray Cast Iron

All questions must be addressed to the Editor, The Foundry, Penton Building, Cleveland.

GRAY IRON

Oxides Are Present

Advice on melting iron in the cupola usually contains a word of caution on bed height to the effect that it should not be allowed to get too low. If the bed becomes too low, the iron melts too close to the tuyeres and becomes oxidized causing blowholes in the finished castings. However, in blowing steel in the converter, air is blown through the molten bath. What prevents the metal from becoming excessively oxidized? Does the carbon that is added before pouring take up the excess oxygen?

Steel blown in the converter hardly could be poured into castings or ingots without a deoxidizing treatment as it is full of oxides, which create a condition usually referred to as wild metal. A test bar taken before the metal is treated will be as full of holes as a Swiss cheese. The deoxidizing agents added to remove the oxides, and quiet the metal are ferromanganese, ferrosilicon, silico-spiegel, etc. Those materials usually are called recarburizers and while the term might convey the idea of adding carbon, the real function of such recarburizers is to deoxidize or degasify the melt. Some carbon is added of course, as ferromanganese, ferrosilicon and silicospiegel contain carbon.

Q & A

Coke Burns Too Slowly

We are having trouble in establishing a consistent melting rate in our cupola. It is lined to 60 inches and our normal melting rate to get good, hot iron at 2650 degrees for valves and high pressure ammonia fittings, is from 10 to 10½ tons per hour. A continuous tuyere 6 inches high is used with 7 openings from the windbox 6 x 17 inches giving a ratio of cupola area to tuyere area of 4 to 1. The tuyere extends to within 6 inches of either side of the slag hole which is 3 inches below the bottom of the tuyere. A good grade of beehive coke containing from 10 to 12 per cent ash is used. Two-thirds of the bed coke is charged and lighted with an oil burner. When that has burned through nicely, the other third is added to make the bed extend 33 inches above the top of the tuyere. Our average heat is about 20 tons of semisteel (20 per cent steel), and 10 tons of gray iron. Charges are 2000 pounds with 300-pound coke splits for the semisteel, and 270-pound coke splits for the gray iron. Sixty pounds of limestone is used per charge. The reservoir in the cupola holds 3 tons, and after starting the blast it takes about 35 minutes to get the first 3 tons of metal. We have tried cutting the coke splits to increase the melting rate, but the iron is not hot enough after the first 4 tons is melted. We have no gage except a mercury pressure gage which shows about 12 ounces. Increasing the pressure above that point chills the iron, and decreasing the pressure slows up the melting rate.

A cupola lined to 60 inches inside should melt from 13 to 15 tons per hour, and the metal should be hot. Therefore, your cupola is melting slowly. From the general tone of the inquiry, we are inclined to question the coke. It may be that its combustibility is too low. It is suggested that you investigate and find out what results other users are obtaining with the coke, or change over to another brand of coke. Our reasons for suspecting the coke are: (1) More air reduces the temperature, and reduction of air cuts the melting rate; (2) The large amount of coke necessary between charges, and (3) Cutting the coke splits reduces the temperature.

Different cokes, as shown by Boegehold, have different rates of combustibility which simply means that some burn faster than others. The faster burning cokes require more air for a given period, and in consequence the iron will melt faster. To obtain the best cupola control it is necessary to know the volume or weight of air supplied to the cupola, and for that reason it is suggested that you invest in some type of air measuring device that will provide that information at all times. It will be money well spent.

Q & A

Iron Shows Shrinkage

We are enclosing a piece of a piston ring which was made in a dry sand mold. The casting in the rough had a metal thickness of 1-inch and was 12 inches long. The mixture included 80 per cent No. 1 machinery cast scrap, 20 per cent steel scrap with ferromanganese and ferrosilicon added in lump form. Analysis of an A. S. T. M. bar showed total carbon, 3.15 per cent; silicon, 2.22 per cent; sulphur, 0.106 per cent; manganese, 0.65 per cent, and phosphorus, 0.41 per cent. You will notice that the fractured ends show a peculiar structure which we are unable to account for. That structure occurred in a place about 6 inches long about 4 inches from the top of the casting. The casting was poured through eight small gates ½-inch in diameter equally spaced around the circumference. As a rule when steel is added to a charge

the metal in the ladles is quite lively, and we make a practice of letting it set until quiet. However, in this case we noticed that the metal was still lively when poured, which might indicate that the metal contained gases.

Close examination of the fracture of the specimen indicates shrinkage and open grain. If the analysis stated is correct, it is almost a certainty that your iron is being oxidized, and probably is low in temperature also. There should be no difficulty in obtaining a quiet metal from the cupola even though considerable quantities of steel are added to the charges if the melting operation is conducted properly. Therefore, we suggest that you check up your cupola operation to see that your bed is of the proper height, that you are using enough coke between charges, and that the proper amount of air is being supplied.

GENERAL

Is Heat Resisting

We desire to make some tests of some of the stainless irons for glass molds. As you know, there is considerable expense involved in the upkeep and replacement of such molds due to oxidation due to the high temperatures to which they are subjected. Can you give us any information on analyses suitable for such work?

If you can use chilled molds, a cast iron containing about 15 per cent each of chromium and nickel will serve well. However, if you need iron that may be machined easily, we suggest that about 20 per cent monel metal be added to the charges, and from 1 to 2 per cent chromium as ferrochromium be added to the ladle of *hot*, molten metal.

Q & A

Acid Cleans Castings

Can you give us a simple acid formula for cleaning medium and small size castings? Also what recommendations do you make for redipping, washing and drying?

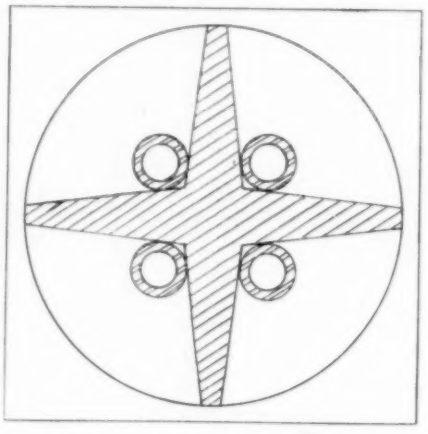
Several acid solutions may be used for pickling or cleaning gray iron and steel castings. The acids used are hydrofluoric, sulphuric, and muriatic. The first mentioned is excellent for removing sand without attacking the metal itself, and is used in the proportion of 1 part of acid to 15 parts of water. Rinse the castings in hot water containing a small quantity of lime as a neutralizing agent. Sulphuric acid is used in the proportion of 1 part of acid to 10 parts of water. Use the solution cold, and rinse the castings in cold water and then in hot water. Muriatic acid solutions consist of equal parts of water and acid.

If castings are pickled in the two latter solutions, they should be watched to see that they are not left in the solutions too long as pitting will take place. Rinsing the castings in cold and hot water alternately will assist greatly in removing the acid from the surface and pores of the castings. Hot water in the last rinse will aid in drying the castings. Final drying may be accomplished by imbedding the castings in hot sawdust which is kept at that temperature by a steam or water bath. Hot air also may be used to dry the castings. All moisture should be removed from the castings to prevent rusting.

Q & A

Use Cast Iron Arbors

In a recent series of articles in THE FOUNDRY *the statement was made that cast iron arbors are used in the green sand cores employed in making soil pipe castings. Does this refer to all sizes including those 2 inches inside diameter? Why is cast iron used instead of wrought iron or steel? I am attaching a sketch of a built up arbor used in German soil pipe foundry practice and will appreciate your opinion of it.*



Sketch of a German Arbor

Steel pipe known in this country as extra heavy hydraulic, is used for arbors in soil pipe 2 inches inside diameter. Cast iron is used for arbors in all sizes above 2 inches on account of its greater rigidity and to some extent on account of the rougher surface which assists the sand to adhere. We have read of the German type arbor to which you refer and believe it is quite efficacious. The original expense of manufacture of course is much higher than that of a length of small steel pipe, but that is, only a minor factor, since the life of either type of arbor is almost indefinite. In certain British foundries we understand that a plain, square cross section, steel bar is used for an arbor for small pipe. To counteract the spring in the center, the ends are wedged slightly in the opposite direction when the mold is closed. This causes the core to dip slightly downward in the center. The pressure of the iron when the mold is filled, springs the core back to an approximately straight line. If you have a back volume of THE FOUNDRY you will find detailed description of small diameter cast iron arbors in the Aug. 1, 1919 issue.

Q & A

Core Sand Spoils Bond

About one-third of the sand in my molds is made of cores and after running the job for three of four days it is almost impossible to wet the sand piles. I have tried various sand mixtures for the cores, but none will blend with the sand in the sand piles. I have tried making the cores so hard that they would not break, but then the iron would not lay against them quietly.

We are at a loss to understand why it should be necessary to allow the spent core sand to mix with the sand in the heaps. If the cores are inside the castings, which presumably is the case, they should not be knocked out until after the castings have been removed to a suitable place clear of the molding floor. As we see it, your problem is not one of developing a core sand mixture that will blend later with your molding sand, but the development of some method to prevent the spent core sand from entering the molding sand heaps.

Again, you do not state whether the molds are poured and shaken out on the floor or on a conveying system. Methods of reclamation applicable to one might not be applicable to another Without further particulars, size of the cores, position in the mold, tonnage per day, shakeout methods and other items it is impossible to suggest a definite remedy. If you are using a naturally bonded molding sand, you cannot expect to absorb spent core sand after each heat. If your are employing a synthetic sand made up of sharp sand artificially bonded with clay, you can adjust your mixture accordingly.

Q & A

Spray Pattern Plates

Some production foundries running plated squeezer jobs, spray a liquid compound on their pattern plates every six or seven molds instead of shaking powder from a bag. We have been told that this compound is made up of coal oil and candles.

We are not familiar with the coal oil and candle mixture, but several foundries use a mixture of half and half coal oil and crude oil for spraying their patterns, particularly where the sand is warm. The mixture is kept in a can or small bucket on the molder's bench or machine. With one hand he dips a 2-inch brush in the mixture and then holds it a short distance away from the pattern. With the other hand he directs the nozzle of his air hose against the brush and thus sprays the material over the face of the pattern. However, it has been found that this material will not act satisfactorily with all sands. You easily can determine by experiment whether it may be used with your sand.

Problems in Nonferrous Founding

By Charles Vickers

Scrap May Contain Zinc

We are located in a foreign country, and can obtain scrap crankcases from old American automobiles. As far as we know, these crankcases are supposed to be made of the No. 12 alloy, composed of 92 per cent aluminum and 8 per cent copper. However, we would like to have that statement verified, because we cannot use such scrap if it contains zinc.

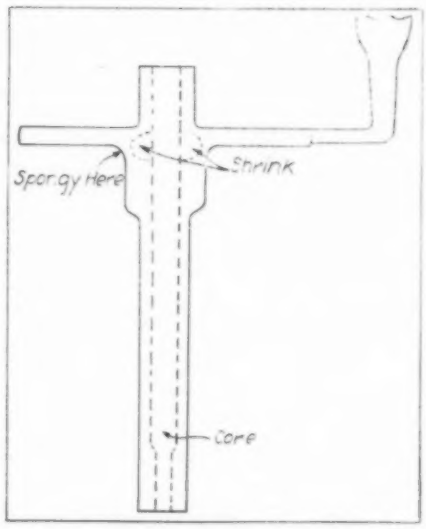
The safest way to determine whether or not the crankcases contain zinc would be to obtain drillings from each case, and analyze them. However, that would be a tedious job. If you are quite certain that the aluminum crankcases were made in the United States, you may be assured that the zinc content will not be over 2.50 per cent. However, if the crankcases were made in Europe, they probably will contain a considerable percentage of zinc. Two alloys are used in this country for making crankcases. One is approximately 92-8, that is it contains 90 per cent aluminum, 7 to 8.5 per cnt copper, 0.20 per cent maximum zinc, and 1.70 per cent maximum iron, silicon, tin, zinc. The other which generally contains considerable secondary metal has the following composition: Aluminum, 88 to 92 per cent; copper, 6 to 8 per cent; zinc, 2.50 per cent maximum; iron, 1.50 per cent maximum, and 0.75 per cent maximum for silicon, manganese and tin.

Q & A

Bronze Casting Shrinks

We are making some hollow bronze lamposts of the design shown in the accompanying sketch. The castings shrink at the underside at the junction of the crossarms and the body. The castings must be watertight, and we have tried casting them horizontally, but it is difficult to hold the core. Different pouring temperatures seem to have no effect. The core, made in halves and pasted with flour is soft, and plenty of venting is provided.

The sketch shows an improperly proportioned casting which undoubtedly is the cause of the shrinkage. The metal thickness of the body at the junction of the arms is about twice that of the upper portion of the body and the arms. The cross arms freeze first, and the heavier portion draws away from the arms as it freezes. It is suggested that the position of the pattern be reversed in the mold, that is place it so that the cross arms are down. That arrangement may eliminate the trouble. The best way to correct the trouble is to make the core larger at the section of largest diameter so that a uniform wall thickness is maintained throughout the casting.



Shrinks Occur in the Heavy Section Near the Arms

Q & A

Blowholes Are in Cope

We are making small castings of a mixture of 36 pounds, 50-50 copper nickel; 40 pounds of copper and 24 pounds of zinc, and have much trouble with blowholes appearing in the cope side. We have vented them with large and small vents, and have tried without vents, but all with the same results as far as this size is concerned. We make some smaller, and some larger ones, which come all right, although the sand and the molds are exactly the same.

We are at a loss to understand how a casting of a medium size will show a high production loss, while other castings of the same shape but larger or smaller, come good. A careful comparison between the way these castings are molded and gated and the other castings that come good should show the reason for the difference sooner or later. For instance, it may be that the cope is lower, then you will have to build up the sprue heads to get more pressure on the castings, of this size.

German silver is a difficult metal to cast. It is just a yellow brass, whitened with nickel, and yellow brass is always hard to cast. It always pays to use a high head, and keep the sprue filled while pouring and probably the addition of half a pound of silicon-copper to each hundred pounds of alloy would help greatly. The better way to vent is to run a knitting needle through the sand of the cope directly over the places where the blows come. That will prevent any air catching at those places, and preventing the metal running up.

Q & A

Contains Zinc and Iron

We have an inquiry for aluminum alloy castings of the composition given in American Society for Testing Materials specification No. 3, or its equivalent with a tensile strength of 19,000 to 21,000 pounds per square inch and an elongation of 1 or 2 per cent. We are unable to find any data on an alloy that will meet such specification, and will appreciate any information you can give.

As far as we are aware, the American Society for Testing Materials does not have any specification No. 3 for aluminum or aluminum alloys. Undoubtedly, your inquiry refers to specification B26-30T, a tentative standard of the society, which relates to aluminum-base alloy castings. The various compositions given in that specification range from *A* to *K*, and the No. 3 which is mentioned probably means grade *C*. That calls for copper, 6 to 8 per cent; iron, 1.5 per cent maximum; silicon, 1.0 per cent maximum; zinc, 2.5 per cent maximum; other impurities, 1.0 per cent maximum, and aluminum, the remainder. The tensile strength of the alloy will have a minimum of 19,000 pounds per square inch, and the elongation will be from 1 to 2 per cent. Society for Automotive Engineers specification No. 33 is quite similar except that silicon, manganese and tin are limited to 0.75 per cent maximum, and other impurities, none.

BILL

By Pat Dwyer

Describes a Rig for Molding a Pot

A CHANCE remark of Bill's the other night touching on an encounter down town with a lad he had not seen for many years prompted the highly original reply on my part that the world is a small place after all. "Oh, I don't know about that." Bill had the old argumentative shield up in a moment. Had he made the statement himself he would have defended it to the last gasp. With all hope gone, he would make one last supreme rally and then fall into the well with the laudable intention of poisoning the water supply. "If there is one thing more than another that makes me tired," he continued, "it is that ready made little statement that the world is a small place after all. If you had to hoof it from here to the west coast, or even to the east coast you would find that this section of the world is just as wide as ever it was and that the distances between mile posts are just as long as they were the first time you tried them out, my lad.

"So far as territory goes the world is just as big as ever it was and if you want to figure the size on a population basis, the world is growing bigger every day. A general war or maybe a small private or semiprivate war turns up every now and again and puts a kink in the population curve, but in round figures—particularly appropriate in discussing worldly affairs—in round figures the population of the world shows an increase from year to year.

"Therefore instead of saying the world is getting smaller—"

Probably I should have allowed him to ramble along. Eventually he would run out of gas and automatically come to a stop. A one sided argument seems to lack the necessary vitamins and calories to sustain life. In this particular instance I indiscreetly fanned the dying flame into life by interrupting to state that I had not said the world is getting smaller. I hate to have people impute to me motives which I do not, never had or never will entertain. In line with this general policy I feel real peeved when any person quotes and credits me with a statement which I know I have not made.

The subject matter may be perfectly harmless, but if it is a misquotation and introduced into an argument I cannot accept it in a spirit of true Christian meekness. Would you? Certainly not! I know exactly what you would say if a person brazenly declared you had said something which you said you had not said. There may be a few extra saids in that statement, but you know what I mean if you have been paying attention.

Goose Creek Probably Will Lose a Visitor

Instead of telling Bill—or any other person—what you probably would have told him, I allowed him to absorb the meaning by himself when I told him that I had said nothing about the world getting smaller.

"Think back dear lad," I said, "if it is possible for you to throw that old one track mind in reverse. Think back to the beginning of the present series of hostilities and maybe the words will come back to you. If you cannot remember what I said—I can see by the furtive eye and the guilty look that your mind is blank—if you cannot remember what I said on that memorable occasion, I now will repeat the statement for your particular benefit. I said that the world is a small place after all."

"After all what? What's the idea of tacking the *after all* on to the end of the sentence? Isn't the plain statement that the world is a small place just as complete as the same statement with the useless tag *after all* dangling from it?"

Reluctantly I had to admit that Bill was right on that particular point, but that did not justify him for claiming that I said the world is getting smaller, when I really had said that this is a small world after —well, either with or without the after all. "What's the difference," Bill said, "how you said it? The meaning is the same in either instance. According to your way of looking at the situation, the fact that I met a man here in Cleveland whom I last had met several years ago in Boston, is evidence that the world is getting smaller, or is a small place or something like that." "Something like that," I admitted. "I simply am amazed at times at the speed you display in grasping the meaning, the essential features of a problem—" "It's a gift, my boy," Bill replied modestly. "A gift, if I do say so myself, brought to a high state of perfection through a long period of cultivation. If you are a good little boy I shall bequeath to you the secret in my last will and testament. Now there is something for you to look forward to. I suppose that *to* at the end of the sentence will give you heart burn or the botts or whatever it is fussy people get when they see or hear a sentence with a preposition on the tail end. Personally I never could see any sense in that silly old rule, but just to be sociable and show there's no hard feeling, I'll shift 'er around so that, reading from left to right—I take it you *do* read from left to right?—the words fall into the following formation: 'Now there's something to which you may look forward.'

"You will note that in this instance the *to* is concealed discreetly in the center of the sentence where it is guaranteed not to offend even the fastidious eye and ear of that most fastidious of all created human beings, a retired school teacher."

"I think you are taking in too much territory," I said. "That statement is too sweeping. All teachers are not afflicted with the preposition complex. Now for instance there is our old friend Louis—"

"The point raised by my honorable friend is well taken," Bill admitted handsomely. "Louis is a good old scout, but then his specialty was mathematics. The gruelling job of hammering that abstruse science into

Illustrated Salesmanship: The Approach

the empty domes of succeeding classes, leaves little time to worry over the niceties of sentence construction, the position of prepositions or the horrors of split infinitives. Coming back to the point at issue—"

"The good old bulldog breed eh?"

"Talking about dogs," Bill remarked, I thought a little more pointedly than necessary. "I wonder if you ever heard of the dog in the manger? No? I'll tell you some day about how he had a tin can tied to his tail.

"My accidental meeting with an old friend in a place I never expected to meet him is no proof that the world is a small place. The world still retains its original dimensions. The population of the United States has increased by approximately 20,000,000 since I last set eyes on this lad. Consequently the coincidence is more remarkable than if the world had shrunk to the size of a 10-acre lot where no one could hide and if the population had shrunk to a baker's dozen.

"Well," I said, "I know one thing and that is you never would have met me if I had known in advance that you are so violently opposed to a good old statement that has bolstered up millions of conversations since Adam and Eve first met accidentally in the garden.

" 'Le's see,' sez Adam. 'Ain't I seen you some place before?'

" 'Oh, Ad!' the lady giggles. 'You do say the killenest things. Of course you remember me. I am one of the Rib girls—Spare, that's me—I pulled out of the old home some time ago and never expected to see it again and here I bump into you the first shot right out of the box.'

"Then and there Adam coined the imperishable statement that through poets and through sages has come ringing down the ages—no, that's from the *Conquered Banner*—Adam gallantly rose to the occasion and removed any lingering traces of embarrassment in the lady's mind by remarking impressively and yet withal with the lightest touch of facetiousness that the world is a small place after all! If this array of ancient and modern instances does not convince you that your criticism is ill timed and without justification I shall just quote you from an advertisement in this morning's paper. I have not the paper by me at the moment, therefore I cannot give you the text word for word, but the general sense is that the telephone system of this country, or for that matter, of any country, is so highly efficient that a man can be located any time, any place."

"I think the advertising man fell into an error there," said Bill. "You know there is such a thing as being too efficient. Have you ever been driven out of bed at 2 o'clock in the morning to tell some pickled pelican that he was calling the wrong number?" "The advertisement did not touch on that angle. The text described in epic style how John Doe left home one day for a leisurely auto trip to the west coast. He had no set itinerary and no definite time schedule. He proposed to travel fast or slow as the spirit moved him and was totally indifferent whether he camped by the roadside or put up at hotels along the way. He made no reservations in advance and therefore did not need to care whether he passed through any given town on Monday of one week or Friday of the following week.

"He craved freedom or as near to absolute freedom as one may attain while remaining within the multiplicity of laws which circumscribe and restrict practically all activities and to that end he planned this gypsy mode of travel.

"All went well for about a week and then conditions at the old homestead arrived at a pass that demanded instant communication with the wanderer. Appeal was made to the local telephone office and the multitudious tentacles of the vast organization were set in motion over a territory that reached from the Mississippi to the coast and from the Canadian to the Rio Grande.

"No one knew where the lad was and as a result the search was made by the well known system of trial and elimination. On a grand scale it was patterned on the fairy story of the old woman who sought the person who had robbed her. She proffered the same request of inquiry to every person she met: 'Maid (or man) o' mine, maid o'thine, did ye see e'er a man from the Rhine. With a wig, with a wag, with a long leathern bag, who stole all the gold and silver ever I had.'

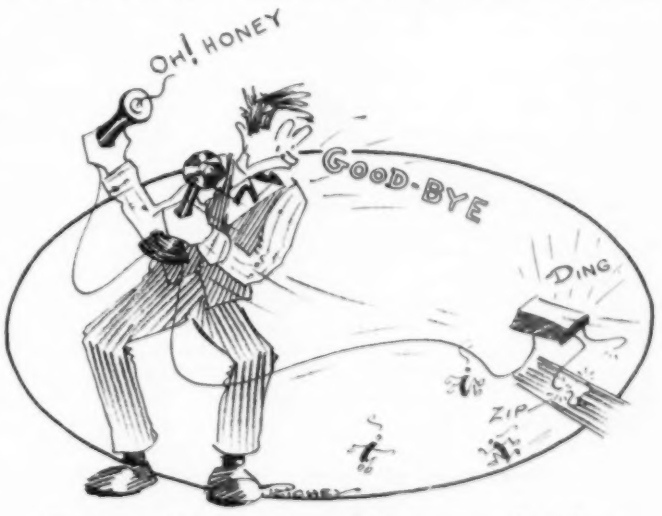
"The old lady eventually won out—as of course we knew all the time she would—and in like manner the telephone finally cornered John Doe in some little out of the way place.

"Now, there is an example of efficiency for you, also a proof, if further proof is needed that the world is a small place after all. Less than 100 years ago a searcher for that man could not have found him in less than six months."

"Seems to me," Bill said, "the story is not exactly complete. Who wanted this John Doe in such a hurry and what was done after he was found and notified? Just imagine poor John rushing up to the telephone with his heart in his mouth and all kind of wild visions flashing through his mind—his house in flames!——his wife gone with a fish peddler!—the baby chewed into small pieces by a vicious dog!—he always had been suspicious of that brute next door.

" 'Hello! Hello!' he shouts. 'Yeah, this is me, John Doe. Tell me! tell me quick!' Then his wife's voice comes floating over the wire to ask him if he is having a good time honey and is he sure he is all right and does he miss her just a little and Oh my dear all the trouble she has had in trying to locate him.

"This touching evidence of wifely



The Best Old Word in the Language: Good-Bye

devotion fills John's cup of happiness to the brim. It slops over when he reflects on the bill to be rendered by the telephone company for the service. He yells, 'Good bye,' tears the instrument out by the roots and disappears for an indefinite period into the wildest fastnesses of the Rocky mountains.

"Of course," Bill admitted, "the telephone has its uses. It is a wonderful time saver when time is an object. A man called me up the other day to say he would appreciate my opinion on the best method of molding a cast iron pot 32 inches inside diameter, 6 feet deep, 1 inch thickness of metal, straight sides and with a flange around the mouth. He makes these castings occasionally in various sizes but not in sufficient quantity to warrant elaborate rigging. He has tried casting them bottom end up, but the bottoms are defective. He asked me to kindly explain the method, the minimum amount of patternmaking and other rigging required to mold the pot with the bottom end down.

Make Mold in Dry Sand

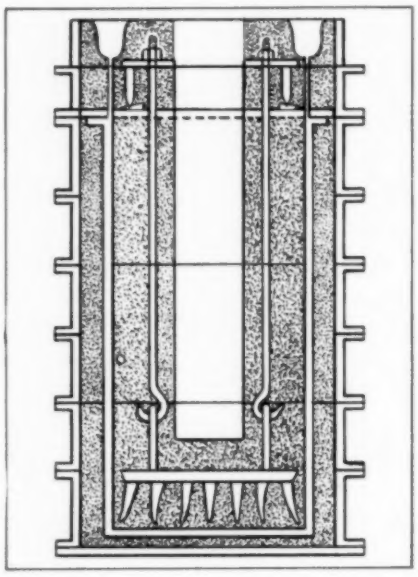
"Under the conditions outlined and assuming from the letter head that he is not equipped for molding the casting in loam, the following method was commended to his attention. The outside of the mold is formed in dry sand in an iron flask. The inside is formed with a dry sand core, made and dried for convenience in two or possibly three sections. The top of the flange is covered with a flat ring core either in one piece or in several sections. This ring core is pierced with 12 gate openings ½ x 1-inch spaced equidistantly and hugs the main core closely, thus preventing an unsightly fin at the mouth of the pot.

"After the mold and core are made and dried, the core is placed in the mold with a ⅞-inch piece of board under the bottom. This board corresponds to the thickness required in the bottom of the pot. The strain on the sand, incident to filling the mold with iron, will increase the thickness to the 1-inch required.

"Three long bolts attached to an arbor in the bottom of the core, extend through the cope where they are secured with suitable nuts and washers. Pieces of thin steel or iron plates and steel wedges are driven between the top of the core and the bottom of the cope bars before the nuts are tightened. Cheek, cope and core then are lifted as a unit and the board is removed from the bottom of the mold. The upper part of the mold then is returned to place. On account of the tremendous strain, the joint between the cheek and the drag must be well made and the flask must be clamped securely in this area.

"The only pattern equipment required is a drum or ring 34 inches diameter and 18 inches high, and a plain ring corebox 32 inches inside diameter and 2 feet high, without either top or bottom. A cover corebox probably already is in existence. If not, one easily may be improvised. Two remaining small pieces of pattern equipment include the flange around the top of the pot and a piece of board with three 1-inch thick guide blocks attached, to center and support the main core before the bolts are tightened up.

"The cope is not rammed until after the main core and covering cores



Longitudinal Section of Completed Mold Showing Suspension of the Core From the Cope

have been placed in the drag. The empty cope then is placed in position and if necessary, suitable thickness pieces are placed on the upper flange of the drag so that the bars in the cope may clear the cores. Gate sticks are placed in the gate openings and the cope is rammed full of sand with the exception of a space in the center forming a continuation of the large opening in the center of the main core. A continuous basin is built on top of the cope.

"Where the pot is flat on the bottom, the lower section of the core may be formed on a core plate with the loops pointing up. If the casting is to have a dished bottom, this section of the core is manipulated to correspond. The arbor is dropped into place in a reversed position, that is with the loops pointing to the core plate. After the box has been rammed full of sand a curved strike, riding on the edges of the corebox, is employed to form the convex surface. This section of the core is inverted after it is dried.

"A 10 or 12-inch thickness of sand is sufficient in the bottom and walls of the core. A 12-inch opening extending from the top to a point within 12 inches of the bottom of the core will save a considerable amount of sand, will facilitate the drying of the core and will provide a liberal outlet for the escape of gas."

A. F. A. Publishes Book on Foundry Sands

The American Foundrymen's association, 222 West Adams street, Chicago, following the recommendations of the committee on molding sand research, has adopted a set of standards and tentative standards for the testing and grading of molding sands and has published a book containing information on those subjects. The book contains 160 pages and 47 illustrations showing testing methods and micrographs of various types of sand. The first part of the book is devoted to the historical development of foundry sand testing and control and gives the names of the many individuals who have played an important part in securing the data now available.

Following the introduction, standard and tentative procedures for sampling and for determination of moisture; permeability, both green and dry; green and dry sand strengths; fineness; and chemical analysis are given. Other determinations for which instructions are given include green sand mold surface hardness; dye absorption qualities; sintering test; core tests; and grading classifications. A bibliography is included in the last section.

Instructions are given for each determination and several methods are included for each test. Information also is given on the underlying theories of each method and the apparatus used as well as a description of the latter. The book is available to members of the association and the price to nonmembers is $3.00.

Electric Ovens Described

Freas Thermo-Electric Co., 1206 South Grove street, Irvington, N. J., recently issued a bulletin describing the part electrical heat plays in industry. The bulletin is divided into three sections. The first compares electric heat and heat generated by other fuels. Some of the questions discussed include first cost, carrying charges, cost of heat, energy, labor charges, maintenance, etc. The second part deals with the principles of electric ovens and dryers and discusses heat effects, transfer and control; ventilation; and efficiency. The third sections shows various types of ovens made by the company with details of construction, specifications, methods of control, auxiliary equipment and many views of typical installations.

Progress Is Reported

The first progress report of the Alloys of Iron Research, Engineering Foundation, New York, which recently was published states that more than 6000 abstracts covering 500 classifica-

tions of the possible 800 devoted to alloys of 40 elements with iron, have been prepared. Work undertaken by the co-operating groups, Battelle Memorial institute, Carnegie Institute of Technology, Lehigh university, and the National Bureau of Standards is progressing favorably. Battelle Memorial institute has completed the review of literature on iron-molybdenum alloys and the manuscript of the monograph is nearing completion. Carnegie institute is making a basic research on iron-manganese. Lehigh university completed a literature survey and prepared a bibliography of iron-silicon alloys and silicon alloy steels. National bureau of standards is reviewing literature on pure iron which is nearing completion, and part of the manuscript has been written.

Casts Large Alloy Steel Retort

CARBURIZING or hardening exceptionally large steel rings for heavy duty roller bearings ranging from 16 to 48 inches in diameter depends upon the foundry in a large measure for its successful culmination. This is shown admirably by the retort depicted in the accompanying illustrations, which recently was made in the foundry of the Driver-Harris Co., Harrison, N. J. The casting is 48 inches inside diameter, 60 inches deep and has a central chimney 12 inches in diameter. It weighs over 4000 pounds and is made of a special nickel-chromium alloy designed to withstand a temperature of 1700 degrees Fahr.

A special steel flask was constructed to hold the sand for the mold. The mold was oven dried for six days and after removal from the oven the cores were set in place. The flask containing the mold and cores then was lowered into a pit in the foundry floor so that the openings of the sprues were about floor level. To insure soundness exceptionally heavy risers were provided. The risers had a total weight of approximately half of that of the casting. The central core was supported by a steel arbor.

The retort was poured upright with the feet formed in sectional cores. A large number of gates insured the rapid distribution of the hot metal. The pouring temperature was 2900 degrees Fahr. Pouring was done from a bottom-pour, preheated ladle. The metal was melted in a 3½-ton, heroult-type electric furnace and was poured into a runner basin which fed the various gates leading to the casting. The finished casting was part of a special furnace built by the American Gas Furnace Co., Elizabeth, N. J., for the Timken Roller Bearing Co., Canton, O.

Wins Guessing Contest

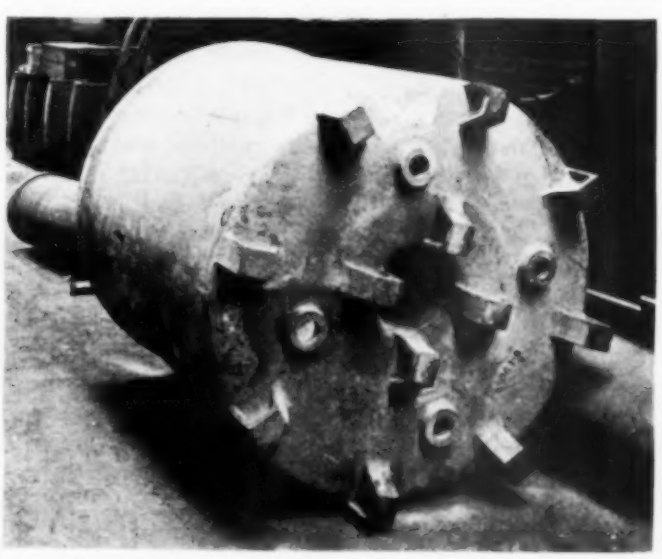
A guessing contest which was featured at the Pangborn Corp. exhibit at the A. F. A. convention relative to the number of abrasive grains that passed through the orifice of a huge hour glass in five minutes has been terminated with awards to the following: J. K. Adams, Barrett Christie Co., Chicago, whose guess was 3,437,400; J. R. Scholes, Sivyer Steel Castings Co., Chicago, with a guess of 3,400,037.

Schedule Conference

The Silver Bay Industrial institute, held under the auspices of the Silver Bay association, Silver Bay on Lake George, N. Y., has scheduled a conference for Aug. 15 to 25 which will discuss various phases of industrial problems. Three divisions meet during that time. The first will be devoted to industrial supervision and will be under the chairmanship of R. N. Keppel, Standard Oil Co. of New Jersey. The second division will discuss plant training and will be under the chairmanship of W. M. Nelson, General Electric Co., Schenectady, N. Y. Frank Cushman and C. F. Klinefelter, chief and assistant chief, Federal Training and Industrial Service will lead several of the discussions. Personnel principles and methods will be the subject of the fourth division. C. R. Dooley, Standard Oil Co. of New York will act as chairman.

Machinery Makers Plan To Consolidate

Foote Bros. Gear & Machine Co., Chicago, is to be acquired by Dodge Mfg. Corp., Mishawaka, Ind., and will be consolidated into a $10,000,000 company to be known as the Dodge-Foote Corp., subject to approval of the stockholders of the companies. The two boards of directors have approved the consolidation plan. Plans are to transfer Foote Bros. manufacturing activities to the Mishawaka plant of the Dodge company. G. C. Miller, now president of Dodge corporation, would be president of the new corporation, and J. F. Griswold, president of Foote Bros. Gear & Machine Co. would be a member of the board of the consolidated company.



The Interior View at the Left Shows the Central Chimney Which Added to the Difficulty of Casting. The Feet on the Base of the Casting as Shown in the View at the Right Were Formed in Sectional Cores

DAN M. AVEY
Editor

The Shakeout

FRANK G. STEINEBACH
Managing Editor

PAT DWYER
Engineering Editor

EDWIN BREMER
Metallurgical Editor

CHARLES VICKERS
Nonferrous Editor

NORMAN F. HINDLE
Assistant Editor

¶ Building a Great Industry

INDUSTRIAL advance in any line depends upon concerted and determined effort of the companies and individuals who form the industry. Trade associations today are a stabilizing influence under trying conditions. Therefore, active participation in trade association work is a direct contribution toward progress in any industry. The Steel Founders' Society of America is the trade association of the steel foundry industry, which since its organization has been active in advancing that field. In 1929, the society was reorganized and incorporated under the state laws of New York and established permanent headquarters in New York.

THE Steel Founders' Society of America has made a marked contribution to the steel foundry industry, in industrial stabilization, curbing of cut-throat competition and protection of the product. The first mentioned phase is promoted by the society's active interest in contemplated steel foundries. The society presents in an unbiased manner to the manufacturer who contemplates entering the steel castings field such problems as the competition he must face, conditions in the territory which he expects to sell, markets and other factors. After complete presentation, the project is carried on or abandoned at the discretion of the prospect, but with the facts before him.

FOLLOWING its incorporation, the Steel Founders' Society of America has accomplished many things. In the reorganization, the membership was divided into three groups devoted to makers of large castings, small castings, and the producers of heat- acid and corrosion resistant alloys and specialties. Such a segregation of products within an industry allows each separate group to discuss and deal with its specific problems. The society renders many direct services to its members. It maintains a technical department for research in markets and new uses of castings; a cost department for the installation of its uniform cost system and to render advice on cost questions; a publicity department which broadcasts information of value to steel castings producers and users. In addition, monthly reports are rendered on operating costs and sales; general business conditions; bookings, production and shipments; and daily bulletins are issued on the current quotations on raw materials. A bureau for employment and replacement and a material exchange also has been established. Co-operation with other organizations is a valuable service rendered.

WHERE for the cost of a few dollars can a steel foundryman secure such a large return as in actively working with his trade association? The upbuilding of the steel foundry industry depends upon concerted and determined effort. The Steel Founders' Society of American offers the steel foundry industry the medium whereby it may increase its scope and bring greater prosperity to steel foundries than they ever before have experienced.

THE FOUNDRY, in the interest of furthering the work and aims of the Steel Founders' society has tendered the front cover of this issue to present a timely message.

¶ Careless Driving

EVERY week end motorist encounters occasional roadside accidents, usually with the assembled crowd of witnesses and near witnesses who listen with eagerness to the fruitless recriminations of the principals. These arguments with attendant inferences upon the lives, mentalities and ancestry of the drivers, each read in detail by the opposite party seldom are productive of any benefit. Often, the exercise of a little common sense both before and after the accident will save injury, loss of time and money.

WHAT has this to do with the foundry business? During the lush period just passed, an occasional collision between a jobbing foundry and the purchasing department of an automobile factory was noted. Charges of unfairness, untruth and other weaknesses approximating those enumerated after a roadside accident were not uncommon. The foundryman frequently was the loser through accepting a contract based upon his competitors prices, quoted to him by the purchaser. The automobile company occasionally charged failures in delivery, quality, etc.

CARE and caution on the part of both seller and buyer of castings in the automotive field would avoid much of the grief encountered in the past. Perhaps the first definite sign of more careful driving, a little more room on the straightening of contract conditions and a little less cutting of price corners, is the announced policy of the purchasing department of one large manufacturer. A new policy will not permit withdrawal of quotations and the submission of new prices. This plant at any rate signals a turn.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

FRED GROTTS became affiliated with the Continental Roll & Steel Foundry Co., East Chicago, Ind., on June 1, as metallurgical engineer, with headquarters at East Chicago and will direct the metallurgical activities of the Hubbard Steel Foundry division, East Chicago, Ind.; the Wheeling Mold & Foundry division, Wheeling, W. Va.; and the Duquesne Steel Foundry division,

Fred Grotts

Coraopolis, Pa. Attending the University of Illinois and the University of Missouri, Mr. Grotts graduated from the latter with the degrees of bachelor of science and metallurgical engineer. For a time, he was industrial metallurgical engineer with the Public Service Co. of Northern Illinois, and in 1916 went with the Curtiss Aeroplane & Motor Corp., Buffalo, as metallurgical and chemical engineer, having technical control over all processes. For his service, he was cited by the governments of the United States, Great Britain, and France. After the war, he joined the Caterpillar Tractor Co., Peoria, Ill., as foundry manager and technical supervisor of the plant, leaving after 7 years service to go with the American Steel Foundries, Granite City, Ill., as superintendent of wheels, the position he relinquished to make his present connection.

H. G. Chase was recently appointed sales manager of Standard Alloy Co., Cleveland. He formerly was identified with General Alloy Corp., Boston.

F. F. Elliott has been appointed mill and general foundry superintendent, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., taking charge of the brass foundry, copper mill and Trafford, Pa. foundry operations. **H. F. Seifert** has been appointed superintendent of the brass foundry and copper mill.

Bert R. Reeves, for the past 5 years connected with the Industrial Brownhoist Corp., Bay City, Mich., and later with the Ohio Steel Foundry Co., when the latter took over the Bay City plant, has become associated with the Babcock & Wilcox Co., Barberton, O., in the alloy steel foundry. Prior to his connection with the Brownhoist company, Mr. Reeves was superintendent of the steel foundry of the Neal Lucey Co., Houston, Tex.

Jules Cury, recently elected president, French Foundry Technical association, is a foundry owner in Deville,

Jules Cury

Ardennes, France. He was born in that city in 1868 and in 1897 succeeded his father and grandfather as proprietor and manager of the gray and malleable iron foundry company, Cury & Troyon. During the war, he was an officer of the territorial army, attached to the minister of munitions for manufacturing semisteel shells. He has been vice president of the French Foundry Technical association since 1911. He also occupies the position of district inspector of technical education and is a member of the administrative council, Paris Foundry high school.

William H. Waltz, formerly steel casting contact engineer, Bethlehem Steel Co., Bethlehem, Pa., has resigned that position to become superintendent, Crucible Steel Casting Co., Cleveland. Mr. Waltz began his foundry career in 1922 following his graduation from Lehigh university, Bethlehem, Pa., when he entered the employ of the Bethlehem Steel Co. to take a special course provided by the company. He entered the steel foundry of that company in the same year as helper and utility man. The following year he was promoted to

Green Pastures

THE engineer who advises his boy to study law, and the lawyer who endeavors to secure a banking job for his son, have many counterparts in business today. The grass on the far side of the fence looks luxuriant and green. The foundryman making jobbing castings, in the face of low demand, seeks a specialty. In the steel foundry branch this looking far afield is evident in increasing measure. Alloy castings, always alluring, look particularly attractive to the manufacturer of carbon steel, when the price per pound, particularly in the high alloy range, is contrasted with the ordinary run of steel castings prices.

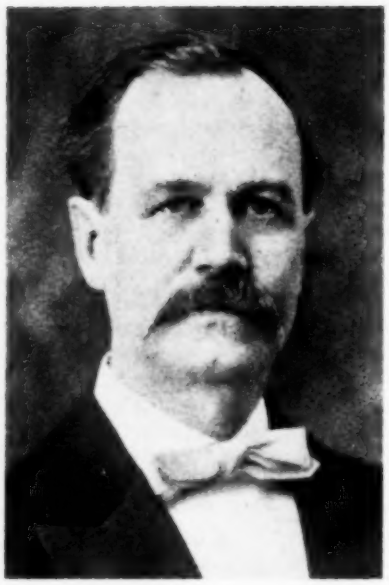
The Lure of the Alloys, by John Howe Hall, steel foundry advisor to THE FOUNDRY staff, starting in the issue of July 15, deals with this subject in an able manner. The thistles, rocks and poison ivy, not always visible from the jobbing foundryman's side of the fence, are uncovered to the public view. Every steel foundryman will profit from a perusal of these articles.

foreman in charge of metal and in 1928 was made assistant superintendent of the steel foundry. In 1930, Mr. Waltz was appointed steel casting contact engineer. During the time he was with the Bethlehem Steel Co., Mr. Waltz assisted in the development of foundry practice for alloy steel castings and rolls.

Pittsburgh Group Meets

About 30 members of the Pittsburgh Foundrymen's association attended the regular monthly meeting held June 15. The program consisted of a general round table discussion on various operating problems. Plans were discussed for association activities during the next year.

Hijos de Valentin Elcoro, 5A Calle de Comonfort No. 57, Mexico, D. F., has changed its name to Talleres Elcoro.



Eben Perkins

OBITUARY

Eben Perkins, president, Perkins Co. Inc., Taunton, Mass., died May 25 at the Union hospital, Fall River, Mass., following a 2-month illness. Mr. Perkins was well known throughout the United States and Europe as the inventor of the cold forge process for the manufacture of horse shoe nails. He was born March 27, 1859 in Bridgewater, Mass., and was educated at a private school, Bridgewater academy and Massachusetts Institute of Technology, Cambridge, Mass. For Many years, he was interested in the horseshoe nail business serving as general manager of the Maritime Nail Co., and the Portland Rolling Mills, St. John, N. B., for a number of years and later becoming associated with the Hoopeston Horse Nail Co., Hoopeston, Ill. Later, Mr. Perkin's patents were purchased by the Capewell Horse Nail Co., Hartford, Conn., and he was

DIRECTORY OF FOUNDRY ASSOCIATIONS

American Foundrymen's Association

President, N. K. B. Patch, Lumen Bearing Co., Buffalo; executive secretary-treasurer, C. E. Hoyt, 222 West Adams street, Chicago; technical secretary, R. E. Kennedy, 222 West Adams street, Chicago. Annual meeting, Stevens hotel, Chicago, May 4-7, 1931.

Associated Brass Founders of New England

President, George W. Thornburg, Crescent Park Brass Foundry, Waltham, Mass.; secretary, Herbert H. Klein, Pennsylvania Foundry Supply Co., 310 Congress street, Boston. Meetings the fourth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. McArthur, Washington Iron Works; secretary, W. J. Wark, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. Hire, Hire Foundry Co., Peoria, Ill.; secretary, Franklin Whitehead, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, L. E. Gilmore, Crane Co., Chicago; secretary, Albert N. Wallin, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, Carl S. Neumann, Union Mfg. Co., New Britain, Conn.; secretary, Charles S. Parker, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Connecticut Nonferrous Foundrymen's Association

President, C. H. Blanchard, Reading Steel Casting Co., Pratt & Cady division, Hartford, Conn.; secretary, C. D. Elliott, Wilcox, Crittenden Co. Inc., Middletown, Conn. Meetings held the second Monday of each month at place to be named. Recent meetings have been held at Hotel Garde, New Haven, Conn.

Detroit Foundrymen's Association

President, James L. Mahon, American Car & Foundry Co.; secretary, Neil I. McArthur, Great Lakes Foundry Sand Co., 2100 Penobscott building, Detroit. Meetings third Thursday in each month, except December, June, July and August at Ft. Shelby Hotel.

East Bay Foundrymen's Association

Secretary, O. R. Moller, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Electric Steel Founders' Research Group

Director, R. A. Bull, Central Office, 541 Diversey Parkway, Chicago.

Gray Iron Institute

President, B. H. Johnson, Florence Pipe Foundry & Machine Co., Florence, N. J.; manager, Arthur J. Tuscany, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. Fauntleroy, Moline Malleable Iron Co., St. Charles, Ill.; secretary, Robert E. Belt, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President, William Ember, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, William E. Paulson, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association

President, W. H. Mantz Atlas Foundry Co., Irvington, N. J.; secretary, G. W. Hannay, Barnett Foundry & Machine Co., Irvington, N. J. Meeting called by president. Scheduled meeting date, May 27.

New England Foundrymen's Association

President, Luther J. Anthony, Glenwood Range Co., Taunton, Mass.; secretary, Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass. Meetings held the second Wednesday of each month excepting July and August at the Engineers club, 2 Commonwealth avenue, Boston. Outings usually are held in the months mentioned.

Ohio Foundries Association Inc.

President, A. H. Kramer, Advance Foundry Co., Dayton, O.; secretary, Robert Hoierman, 418 Penton building, Cleveland.

Pacific Coast Founders Association

President, Charles J. P. Hoehn, Enterprise Foundry Co., 2902 Nineteenth street, San Francisco; manager, S. M. Truitt, 55 New Montgomery street, San Francisco.

Philadelphia Foundrymen's Association

President, C. F. Hopkins, Ajax Metal Co., Philadelphia; secretary, Earl Sparks, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, H. F. Siefert, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; secretary-treasurer, William J. Brant, Wm. J. Brant, Bessemer building, Pittsburgh. Meetings on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, E. A. Gullberg, Union Malleable Iron Works, East Moline, Ill.; secretary-treasurer, Stanley Brah. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, Horace R. Culling, Carondelet Foundry Co., St. Louis; secretary-treasurer, Leo J. Filstead, John C. Kupferle Foundry Co., St. Louis. Meetings the fourth Thursday of the month at 6:30 p. m., at the American Annex hotel, Sixth and Market streets, St. Louis.

Southern Metal Trades Association

President, John S. Schofield, J. S. Schofield's Sons Co., Macon, Ga.; secretary, W. E. Dunn Jr., Flatiron building, Atlanta, Ga.

Steel Castings Development Bureau

Research Director, George Batty, 500 Stock Exchange building, Philadelphia.

Steel Founders' Society of America

President, W. H. Worrilow, Lebanon Steel Foundry, Lebanon, Pa.; managing director, G. P. Rogers, Graybar building, New York.

Tri-City Technical Council

Chairman, C. F. Scherer, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. Xander, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, William Hoppenjanz, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, C. C. Erhart, Chris Erhart Foundry Co., Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, William J. Snyker, St. Paul Foundry Co., St. Paul; secretary-treasurer, C. E. Langdon, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. P. Jensen, Prescott Co., 1 West Lander street, Seattle; secretary, Edward C. Gustin, 3716 Grayson street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Western Foundrymen's Association

President, H. T. Hornsby, Joplin, Mo.; secretary, E. L. Graham, Acme Foundry & Machine Co., Coffeyville, Kans.

Wisconsin Gray Iron Foundry Group

Secretary, W. F. Bornfleth, Cutler-Hammer Inc., Foundry Division, Milwaukee. Meetings on second Wednesday of each month at Hotel Schroeder, Milwaukee.

retained as consultant. He retired in 1912 but in 1918, Mr. Perkins, his brother, H. K. Perkins and C. O. Breach bought the Trefethen Brass Foundry, Taunton. The partnership was dissolved in 1923 and in 1927, Mr. Perkins opened a new foundry on Ingell street, Taunton.

George Buchanan, president, Long Island Foundry Co., Long Island City, N. Y., died recently.

Joseph J. Kwis, 74 years old, president and general manager, Model Foundry & Machine Co., Findlay, O., with which he had been identified for 40 years, died recently at Cleveland.

Alfred T. Wagner, Detroit, 50 years old, salesman of foundry supplies died recently as a result of an automobile accident.

Charles A. Carlson, aged 63 years, foreman, Ottumwa Iron Works, Ottumwa, Iowa, died recently. He had been employed by the Ottumwa company for 45 years and had been foundry foreman for the past 14 years.

John A. Howard, for many years chief engineer, American Radiator Co., New York, died recently in Buffalo following an illness of several months. He was 59 years old, having been retired a year prior to his death.

Albert N. Abbe, 71, vice president in charge of purchases and director, American Hardware Corp., New Britain, Conn., died May 29. In 1887 he became purchasing agent for the P. & F. Corbin Co. and when it merged into American Hardware Corp. in 1903, he was retained in that capacity. He later was elected vice president.

Albert Barnett, aged 48 years, core room superintendent, International Harvester Co., Richmond, Ind., died recently. Prior to his connection with the International company, he had served in a similar capacity with the Muncie Foundry & Machine Co., Muncie, Ind.; Weil-McLain Co., Michigan City, Ind.; Hoosier Iron Works, Kokomo, Ind.; and the Lycoming Mfg. Corp., Williamsport, Pa.

John Oliver Henshaw died at his home in Cambridge, Mass., June 7, at an age of 74 years. He was graduated from Massachusetts Institute of Technology in 1878 and later attended the University of Michigan. He became identified with the sale of pig iron when he joined the staff of the N. S. Bartlett & Co., Boston. Later he was associated with Hickman, Williams & Co., Philadelphia, and recently he was in business for himself representing Alabama furnaces.

Frank K. Billett, for the past 8 years, head of the cost accounting department, Toledo Scale Co., Toledo, O., has been appointed secretary. Mr. Billet has been with the company for over 10 years.

ConnecticutFoundrymen Re-elect Officers

All officers for the past year of the Connecteut Foundrymen's association were re-elected unanimously at a meeting June 12 held at Kayrock Inn, East Hampton, Conn. They include: President, C. S. Neumann, Union Mfg. Co., New Britain; vice president, B. W. Spencer, Bradley & Hubbard Mfg. Co., Meriden; secretary, C. S. Parker, Charles Parker Co., Meriden; treasurer, G. R. Holmes, McLagon Foundry Co., New Haven. The board of managers include H. R. Brown, McLagon Foundry Co., New Haven; J. D. Coltman, Bullard Machine Tool Co., Bridgeport; H. S. Washburn, Plainville Casting Co., Plainville; W. J. Maton, Waterbury Farrel Foundry & Machine Co., Waterbury. After a session of the local branch of the Gray Iron institute and a business meeting of the association, the members heard an address on gates and risers by Pat Dwyer, engineering editor, THE FOUNDRY, Cleveland.

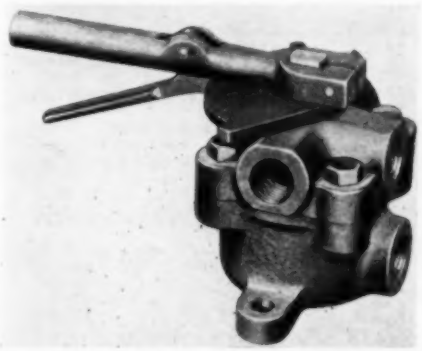
Equipment Makers Hold Election Of Officers

At a meeting of the Foundry Equipment Manufacturers association, held in Cleveland, June 12, H. S. Simpson, National Engineering Co., Chicago, was elected president and J. P. Jones, General Electric Co., Schenectady, vice president. These officers with H. S. Hersey, C. O. Bartlett & Snow Co., Cleveland; M. C. Sammons, Wadsworth Core Machine & Equipment Co., Akron, O.; and H. J. Koch, Fort Pitt Steel Casting Co., McKeesport, Pa., compose the board of directors.

R. P. Dryer who has been acting as secretary-treasurer for the association, resigned to devote his entire time to the Steel Office Furniture institute, and Dan M. Avey, THE FOUNDRY, Cleveland, was elected secretary-treasurer.

Four-way Valve Built for Molding Machines

Galland-Henning Mfg. Co., Milwaukee, has developed a special air valve for jolt-squeeze and squeeze-draw molding machines. A throw of the valve safety handle to one side operates the jolt and by throwing it to the opposite side the squeeze is operated. Both cylinders of the valve are exhausted fully by throwing the valve to the center or neutral position. It is claimed that the operation of the valve is easy because it is not operated against air pressure also, the valve handle need not be held in jolt or the squeeze position.



Valve Handle Need Not Be Held in Either the Jolt or Squeeze Positions

Flexible Shaft Machine Has Four Speeds

United States Electrical Tool Co., 2490 West Sixth street, Cincinnati, recently has placed on the market a new belt-driven, flexible shaft machine with speeds of 950, 1250, 2400 and 3600 revolutions per minute. It is available in popular horsepower sizes and in overhead, vertical, floor, stand, bench and horizontal models. A complete line of tools and attachments for flexible shaft uses is included. New features of the machine include a spiral bearing, improved slide couplings, etc.

Shaft Speeds May Be Varied From 950 to 3600 Revolutions Per Minute

New England Founders Hear About Gates

In accordance with a long established custom the New England Foundrymen's association will hold no formal indoor meeting in the months of July and August. A committee appointed to arrange an outing for July reported all arrangements practically completed at the regular meeting June 10 held in the Engineer's club, 2 Commonwealth avenue, Boston. The address of the evening was delivered by Pat Dwyer, engineering editor, THE FOUNDRY, who chose for his subject a description of gates and risers and the part they play in the production—and loss—of castings.

President Luther J. Anthony read an invitation from the Associated Brass Founders of New England to attend the meeting of that association on June 24 at the Engineers club.

Ball Type Transfer Has Foundry Application

A new type of handling equipment, designed to accommodate the movement of smooth, hard surfaced objects in any direction on a horizontal plane recently has been introduced by the Mathews Conveyor Co., Ellwood City, Pa. The device consists of a large hardened steel ball which rotates on a series of smaller balls held in a cupped base as shown in Fig. 2. A dust and dirt cap rests on the large ball and is held in position by a spring retainer. The cap's knife edge contact with the large ball deflects foreign substances which might clog the supporting balls if admitted to the base, it is claimed.

Two models are available, one for mounting in series on a table or flat surface support, and one for mounting on pipe supports. When mounted in groups on a heavy structural support, the ball transfer provides a method of moving heavy shapes for conveying boxes to and from a line of roller or power conveyors, or for handling heavy cores or molds when those loads are placed on smooth bottom plates.

Fig. 1—A Hard Steel Ball, Rotating on Smaller Balls, Conveys the Materials

The ball transfer, shown in Fig. 1, is constructed with a 4-inch diameter round base, with 4 holes for mounting; other types have a 3-inch square base with four holes for mounting; and a threaded coupling base for 2-inch standard pipe. Those three types have a load rating of 200 pounds each, and are equipped with a 1½-inch diameter hardened steel ball supported on one hundred and five, 3/16-inch, hardened, steel balls carried in a heavy hardened steel base.

Another type ball transfer is similar to one previously described but is of heavier proportions throughout, and has a load rating of 500 pounds each. The base is of drop forged steel, threaded for 2-inch standard pipe. The 2-inch diameter hardened steel ball is supported on sixty-five, 5/16 inch, hardened, steel balls.

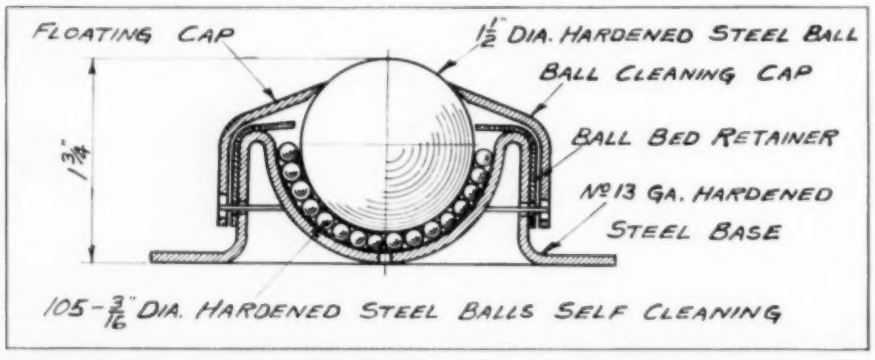


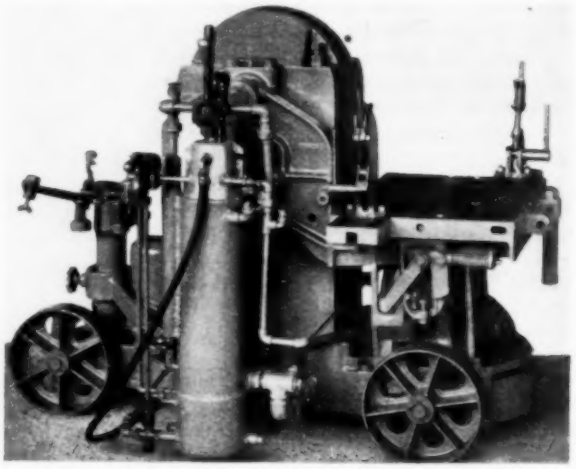
Fig. 2—Layout Showing the Construction and Features of the Transfer

Rollover Locking Device Is Automatic

Tabor Mfg. Co., 6225 Tacony street, Philadelphia, recently developed a new jar, rollover, pattern draw molding machine which has a long stroke jarring blow and is claimed to require a minimum time for rammings molds. The rollover mechanism is oil controlled and rolls over the mold in 4 seconds. The table is free of the rollover frame during the jarring operation but is locked securely to that frame when the machine is rolling over. The locking device is automatic and positive.

The leveling mechanism is automatic and levels the flasks instantly when the device contacts with the bottom board of the flask on the machine. The operator is not required to touch the leveling mechanism as it is controlled from the valve stand of the machine. The pattern drawing mechanism also is oil controlled and is designed to give a slow start and steady draw. The pattern draw guide is self-aligning and is equipped with ball bearings. It is oiless and requires no lubricant.

The machine is enclosed fully and is protected from sand. Specifications are as follows: Table size, 18 x 28 inches; draw, 10 inches; jar cylinder, 4½ inches; rollover cylinder, 7 inches diameter; and capacity, 350 pounds with 80 pounds pressure. The accompanying illustration shows a view of the new machine.



The Table Is Free of the Rollover Frame During the Jarring, but Is Locked to the Frame when Rolling Over

Hoist Is Equipped With New Type Motor Brake

Euclid Crane & Hoist Co., Euclid, O., has placed on the market a new compact and fully enclosed hoist, designed for low headroom operation. The hoist is manufactured in 1, 1½ and 2 ton capacities. Every shaft in the new unit is equipped with heavy-duty, heat treated, roller bearings with solid races, fully enclosed hook block and a new positive, automatic load brake. The brake is free from frictional resistance while hoisting but the load remains under positive control. The brake sets automatically when the hoisting motor is stopped. The load can be lowered only by reversing the motor.

A new type motor brake is provided which stops the motor instantly when the controller is thrown into a neutral position. The hoist is driven by a large, heavy-duty motor made by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The trolley is designed for easy installation either parallel with or at right angles to the I-beam. The hoist has been tested under various conditions with a 100 per cent overload, according to the manufacturers.

Brass Founders Meet

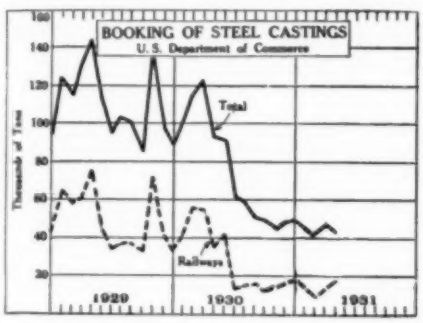
The regular monthly meeting of the Associated Brass Founders of New England was held May 27 at the Engineers club, Boston. Ernest G. Jarvis spoke on the subject "Brass Foundry Mixtures."

Trade Trends in Tabloid

SEASONAL influences remain in the picture as industrial production in general continues to decline gently to lower levels. With perhaps a few exceptions, foundry operations have held at about the same rate during the past few weeks. Reports from various centers show that numerous plants are on better schedules than earlier in the year.

—T—T—

Building awards declined from $336,925,200 in April to $306,079,100 in May, according to the F. W. Dodge Corp. While a similar decline was registered during May, 1930, awards



in June jumped to the highest point of that year.

—T—T—

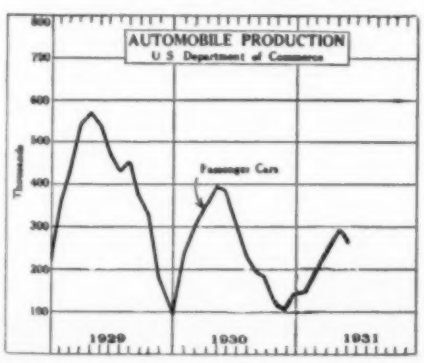
Based on the rate of production at the middle of the month, it is estimated that the output of automobiles in June totaled 285,000 units compared with 325,000 units in May. Thus far this year, the automobile industry probably has been the brightest spot in the industrial picture.

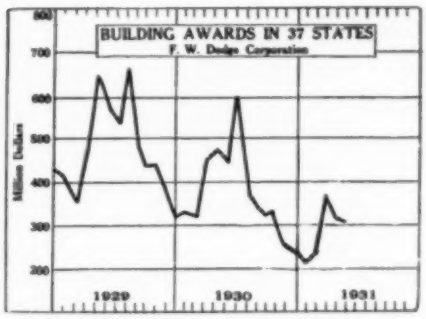
—T—T—

Improvement in railroad car buying was noted recently with the award of 500 box cars by the Chicago Great Western and the report that an inquiry for 800 refrigerator cars would be introduced soon. This follows the poorest month in car buying in years.

—T—T—

Foundry operations in the Chicago district were slightly under 30 per cent around the middle of the month. The demand for automobile castings





fell off sharply the first half of June and one foundry making that type of castings practically will be down until Aug. 1.

—T—T—

Loadings of revenue freight for the week ended June 6 totaled 760,890 cars, a new peak for 1931, according to the car service division of the American Railway association. The drop the preceding week occasioned by the holiday, was not as great as usual.

—T—T—

Jobbing shops in the St. Louis district manufacturing miscellaneous work report a pick up in business since the last of May. Several stove manufacturers also have improved operations. However, shops specializing in automotive and railway equipment castings are extremely quiet.

—T—T—

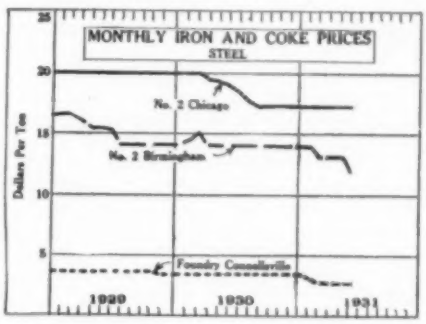
The agricultural outlook is reported as exceptionally good in nearly all parts of the country, with danger from a continuation of the drought definitely gone.

—T—T—

According to the Gray Iron institute, production of member companies in April was 58.2 per cent of normal compared with 60.4 per cent in March. New business was 60.9 per cent against 66.9 per cent the previous month.

—T—T—

While May orders for machine tools tapered off slightly, the three months moving average gained a point on the basis of the March showing, according to the National Ma-



chine Tool Builders association. The index for May was 87.2 compared with 105.1 in March.

—T—T—

Production schedules of cast iron pipe in the Birmingham district are being maintained at 50 to 60 per cent of capacity.

—T—T—

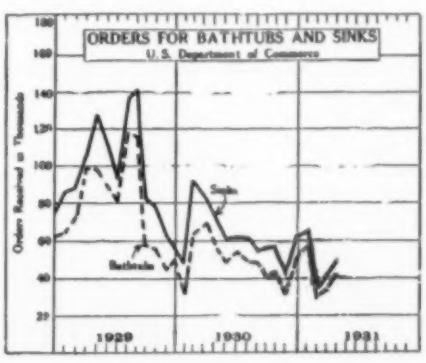
Foundry operations in the Seattle district continue on a considerably reduced schedule, with many plants melting only once or twice a week.

—T—T—

Slackening demand for pig iron resulted in the blowing out of several furnaces the first part of June.

—T—T—

Output of malleable foundries in the Philadelphia district in April increased over the production in March, according to the University of Pennsylvania. Gray iron and steel branches of the industry showed declines.



RAW MATERIAL PRICES
June 18, 1931

Iron	
No. 2 foundry, Valley	$17.00
No. 2 Southern, Birmingham	12.00 to 13.00
No. 2 foundry, Chicago	17.50
No. 2 foundry, Buffalo	17.00
Basic, Valley	17.00
Basic, Buffalo	16.50 to 17.00
Malleable, Chicago	17.50
Malleable, Buffalo	17.50
Coke	
Connellsville beehive coke	$3.25 to 4.75
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.00
Scrap	
Heavy melting steel, Valley	$ 9.50 to 10.00
Heavy melting steel, Pitts	10.00 to 10.50
Heavy melting steel, Chicago	8.50 to 9.00
Stove plate, Buffalo	7.75 to 8.00
Stove plate, Chicago	7.00 to 7.50
No. 1 cast, New York	7.75 to 8.00
No. 1 cast, Chicago	8.75 to 9.25
No. 1 cast, Philadelphia	11.50 to 12.50
No. 1 cast, Pittsburgh	10.50 to 11.00
No. 1 cast, Birmingham	9.00 to 10.00
Car wheels, iron, Pittsburgh	11.00 to 11.50
Car wheels, iron, Chicago	9.50 to 10.00
Railroad malleable, Chicago	9.50 to 10.00
Agricultural mal., Chicago	9.00 to 9.50
Malleables, Buffalo	10.50 to 11.00
Nonferrous Metals	**Cents per pound**
Casting copper, refinery	$ 7.75
Straits tin	22.70
Aluminum, No. 12, producers	22.00
Aluminum, No. 12, remelt	9.00 to 10.50
Lead, New York	3.75
Antimony, New York	6.00 to 6.05
Nickel, electro	35.00
Zinc, East St. Louis, Ill	3.35 to 3.40

What the Foundries Are Doing

Reflecting the Activities of Gray Iron, Malleable, Steel and Brass Shops

Paragon Die Casting Co., 2701 North Crawford avenue, Chicago, makes aluminum die castings.

John Hunker, Fairchance, Pa., makes brass castings and operates a machine shop.

Clarinda Mfg. Co., and the Leslie Mfg. Co., Clarinda, Iowa, have been merged to form the Leslie Corp.

Adelaide Brass Works, Linden and Fourth streets, Allentown, Pa., has discontinued business.

Hamburg Plow Works, Hamburg, Pa., reports business good with a 5 and 6 day operating schedule.

Fulton Brass Foundry Inc., Newark, N. J., has been incorporated with $50,000 capital by M. H. and C. E. Cohn, 60 Park place, Newark.

Preferred Foundry & Machine Corp., New York, has been incorporated with $100,000 capital by F. I. Slater, 265 East 201st street, New York.

Warren Foundry & Pipe Co., 91 Federal street, Boston, has let the contract for a 1-story foundry building which will cost approximately $40,000.

Atchison Specialty Mfg. Co., 1608 Pacific avenue, Atchison, Kans., recently completed a new foundry, 105 x 310 feet, with a pattern storage above.

Lawrenceville Bronze Co., with offices formerly located in the Fulton building, Pittsburgh, has moved its offices to 401 Bessemer building.

Waterloo Foundry Co., Mitchel avenue and Rock Island railroad, Waterloo, Iowa, manufactures gray iron castings.

McCollum Hoist & Mfg. Co., Downers Grove, Ill., is a maker of die castings. The company also operates a machine shop.

Central Pattern Works, 1382 Market street, south, Canton, O., has changed its name to the Central Pattern & Castings Co.

Bosshardt Steel Corp., Allen avenue, southeast, Canton, O., expects to start the production of steel castings in the near future.

Budd Wheel Co., Philadelphia, has purchased the brake drum business of the Holley Permanent Mold Machine Inc., Detroit.

Foundry department of the Wenzelmann Mfg. Co., Galesburg, Ill., has been reopened after being closed for several years.

Kutztown Foundry & Machine Co., Kutztown, Pa., which has been operating on a 4-day average up to April 15, now is working full time.

Werner Foundry Inc., Eighth street and C. & R. railroad, Lansdale, Pa., has increased operations to a 6-day week basis.

Doehler Die Casting Co., High and Washington streets, Pottstown, Pa., reports an improvement in demand for castings during the past 30 days.

The name of the Burch Plow Corp., Crestline, O., has been changed to the Burch Corp. The company no longer manufactures plows.

Machined Steel Castings Co., South Mahoning avenue, Alliance, O., is erecting a 1-story building, 50 x 100 feet, to be used as a flask storage. W. E. Trump is general manager.

Omaha Steel Works, 609 South Forty-eighth street, Omaha, Nebr., is building a 3-story foundry office, pattern shop and pattern storage building, 64 x 68 feet, at a cost of $25,000.

Western Brass & Aluminum Foundry, 121 South Thirty-seventh street, Council Bluffs, Iowa, is engaged in the manufacture of brass and aluminum castings. W. C. Lang is proprietor.

Ideal Specialty Mfg. Co., Fourth avenue and Spruce street, Ryersford, Pa., manufacturer of gray iron, brass and aluminum castings, has been operating 6 days per week since May 1.

Holland Furnace Co., Eighth avenue and L. & N. E. railroad, Bethlehem, Pa., has been operating on a 6-day week schedule since April 1. Charles R. Tunley is works manager of the Bethlehem plant.

Federal Steel Foundry Co., Chester, Pa., which recently was purchased by the Baldwin Locomotive Works, Philadelphia, has been merged with the Standard Steel Works Co., Burnham, Pa. (Noted June 15.)

Round Oak Furnace Co., Dowagiac, Mich., succeeds the Beckwith Co. The company operates a foundry for the manufacture of gray iron castings and maintains machine and pattern shops and laboratory.

Watervliet Iron & Brass Foundry Inc., Watervliet, N. Y., has increased its capital from $25,000 to $75,000. The new capitalization will be used for expansion purposes. Plans are not yet complete.

General Motors Corp., General Motors building, Detroit, is reported to be negotiating for the Toledo, O., plant of the National Malleable & Steel Castings Co., Cleveland. The site includes 60 acres.

Ford Bros. & Co., Philadelphia, has been incorporated with $5000 capital by Lawrence S. Ford, 6007 Clifford terrace, and Albert Bourgeois, 5840 North Fairhill street, to manufacture and deal in castings and forgings and sheet metal.

American Iron & Bronze Works, Oakland, Calif., is establishing operations at 1080 Fifth street, with 4000 square feet of floor space. Paul Romack and R. W. Weeks are interested in the company. Products will include ornametal iron and bronze work.

State commission of administration and finance, 10 Capitol street, Stillwater, Minn., is having plans prepared for a foundry addition at the state prison at Stillwater. Ellerbe & Co., 525 Minnesota building, is the architect. Cost is estimated at $35,000. (Noted Feb. 15.)

Peerless Foundry, Twenty-seventh, West and Commodore streets, Seattle, Wash., has been organized to succeed the foundry department of the Gubowsen Grei Engineering Co. The foundry produces gray iron, brass and aluminum castings.

Trenton, Ill., chamber of commerce is in communication with interests represented by Walter Gleathaer, East St. Louis, Ill., and is negotiating for the establishment of a foundry for the production of stoves and furnaces at Trenton.

Browning Co., Diamond street, Ravenna, O., subsidiary of the Browning Crane Co., Cleveland, plans the installation of an electric steel melting furnace. An annealing oven is the only additional equipment included in the plans. M. P. Richard is general manager, and Leon Hubbell is vice president.

National Brass Mfg. Co., with a factory at 1115 Marshall avenue, Cincinnati, and offices at suite 804-5 Fountain Square building, succeeds the T. A. Wayne Co. The company manufactures gray iron, malleable, brass and aluminum castings, maintains machine and pattern shops and a laboratory. George S. Houston is president and owner.

Bassett Foundry Co., Adrian, Mich., has been organized to take over the Adrian Castings division, Consolidated Concrete Machinery Corp., Adrian. That company formerly was the Adrian Casting Co. and before that was the Adrian Steel Casting Co. The company manufactures gray iron castings and maintains a pattern shop.

Delco Remy Corp., Anderson, Ind., has purchased the Butler Mfg. Co., Indianapolis, Ind., makers of aluminum pistons, and will move the plant to Anderson. At present the Butler plant is known as the Bu-nite piston plant. It operates, in addition to its foundry, a machine shop, pattern shop, and laboratory.

Reading Casting Co., Birdsboro, Pa., has been purchased by Samuel Hoppel and associates and has been renamed the Birdsboro Casting Co. The company began operations under the new name June 1. Officers of the company are: Samuel Hoppel, president and treasurer, and F. W. Scheffey, vice president and treasurer. Jacob Beiler is works manager and Ambrose Pennypacker, foreman.

Carran Foundry & Smelting Works Inc., Ludlow, Ky., which recently was noted as being incorporated, is the new name for the R. B. Carran & Sons Co. The company has been in business as a foundry for 50 years and the adoption of the new name was brought about by the expansion of the smelting facilities. The company has added the production of ingot metals to its manufacture of brass bearings, castings and babbitt metal. (Noted June 15.)

Trade Publications

PULLEYS—A complete line of pulleys and sheaves are described and list prices given in an illustrated catalog issued recently by Henry Lindahl Foundry & Machine Co., 5900 Ogden avenue, Chicago. V-belt drives also are listed, and engineering belt drive charts and tables are given.